Employee Residential Location Choice:
How Existing Supply and Neighborhood Characteristics Impact Housing Preferences in Chapel Hill, N.C.

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Abstract

Chapel Hill, North Carolina is an intriguing case study with which to explore housing options for specific populations. The established institutions of UNC-Chapel Hill and UNC Hospitals offer centralized employment options that attract faculty and staff from throughout the region and across the country. Unlike some cities where both housing and employment options are decentralized, the latter is not the case in Chapel Hill as both institutions are firmly rooted in the community. Despite this centralized location, employees live both within and outside town limits because of the interplay between limited affordable housing supply, high prices for existing units, income constraints, and neighborhood characteristics that may impact residential location choices. This study explores the residential location patterns of three employee population groups – delineated by household income and employer type – and investigates the individual, household, and neighborhood characteristics that correlate with their residential location choices. This study finds that while individual and household characteristics are not correlated with residential location choice, employees within each group tend to reside distances away from UNC-Chapel Hill that have similar characteristics such as racial composition, educational status, and degree of homeownership within neighborhoods. This study also provides an example methodology of how to explore the distance away from campus that newly-employed workforce households would likely live if income was not a constraining factor and all pertinent independent variables were tested.

Chapter 1 – Introduction

Administrative bodies of all organizations – whether public, private, or nonprofit – should be concerned with the availability of quality, affordable housing for the workforce. Without diverse housing options, talented employees of all salary ranges may be unable to accept or retain employment, thus reducing the effectiveness of that organization over time. Factors outside the control of any particular employer, such as macroeconomic conditions and political agendas, may influence the housing options available in a community. Nonetheless, it is within the control of employers to investigate the housing patterns of employees to determine where, if possible, mutually-beneficial programs can be implemented.

Chapel Hill, North Carolina is an intriguing case study with which to explore housing options for specific employee populations and identify mutually beneficial solutions. The established institutions of the University of North Carolina at Chapel Hill (UNC-Chapel Hill) and UNC Health Care (collectively UNC Hospitals) offer high-quality employment options that attract faculty and staff from throughout the region and from across the country. Once they relocate to the region, employees must decide whether to live in Chapel Hill and therefore be close to both institutions, or to live in a surrounding community. UNC-Chapel Hill and UNC Hospitals are fixed-location employers located within a diverse, interconnected region; as such, the potential housing options are similarly diverse and widespread.

As housing costs are very high in Chapel Hill compared to the region, this study differentiates employees by income, explores the available housing options for each sub-group, and analyzes employees' existing residential choice preferences. Employees of both UNC-Chapel Hill and UNC Hospitals are delineated by income into two categories: employees living in households of low to moderate incomes and those employees living in households of higher incomes. The purpose of this study is to support ongoing research into the affordable housing options available for employees affiliated with UNC-Chapel Hill and UNC Hospitals. The included research may also be applied to other small but growing towns with high housing costs, fixed-location employers, and commuter employee populations. In particular, this study seeks to support the dialogue about whether UNC-Chapel Hill should become engaged in what is called "university employer-assisted housing." Unanswered questions around this ongoing discussion concern the

residential housing preferences of existing employees and how university-driven residential housing development could expect to fulfill these preferences to meet employee demand.

The remainder of this study is divided into chapters. Chapter 2 provides background information that prompted this study. Chapter 3 highlights the academic literature relevant to the following study, while Chapter 4 offers further information on the full context of affordable housing in Chapel Hill. Chapter 5 reviews recent housing studies conducted by both UNC-Chapel Hill and the Town of Chapel Hill to investigate the affordable housing problem. Chapter 6 outlines the three research questions specifically addressed by this study, and Chapter 7 reviews this study's methodology, including relevant assumptions and variables. Chapter 8 presents tabulation and regression results of existing residential preferences, while Chapter 9 applies these findings to the likely residential location choices of workforce employees newly hired at either institution. Chapter 10 concludes with a discussion of the results and suggestions for future studies.

Chapter 2 – Background

Three long-standing realities highlight the need of this study on the housing preferences of workforce households in Chapel Hill: (1) population growth and the town's prominence within the region, (2) the increasingly decentralized housing patterns of university and hospital employees, and (3) ongoing discussions of the potential for the development of affordable, workforce housing by both UNC-Chapel Hill and the Town of Chapel Hill. A lengthy discussion of all factors affecting residential housing markets, both in the past and in today's more complicated economic conditions, is beyond this study. The ongoing credit crunch, record numbers of foreclosures, dwindling family savings, and persistent unemployment (to name a few) strongly impact current housing conditions for all residents and should not be blindly dismissed. However, it is within the current context of the three issues below that this study's findings should be most closely considered.

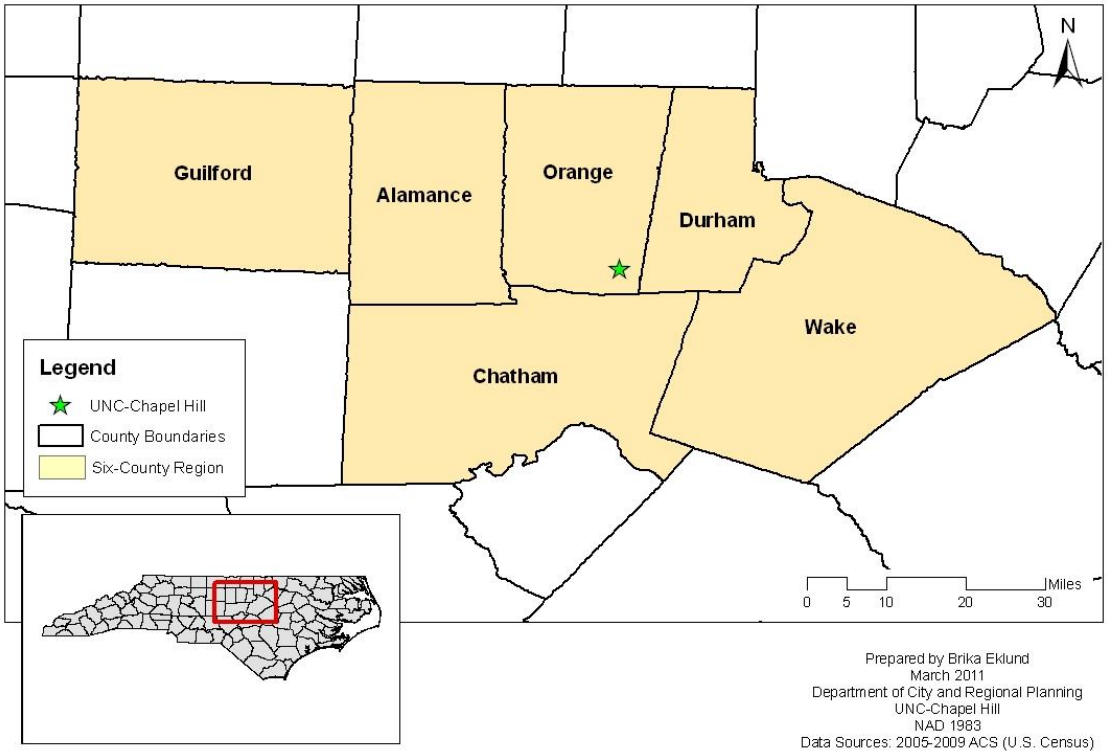
2.1 Chapel Hill, North Carolina

Chapel Hill (hereafter referred to at times as "the Town") is a mid-sized town located in the region of North Carolina widely known as the "Triangle." The Triangle, which includes Raleigh, Durham, Cary and nearby smaller towns, has grown substantially over the past two decades because of high-value technological and business investments in the Research Triangle Park, strong universities and public school systems, and a general nationwide trend of resident relocation and foreign immigration to southern cities. The Raleigh-Durham-Cary Combined Statistical Area (CSA) doubled in size from 1990 to 2009 with a current population estimated at between 1.63 and 1.74 million residents (Development Concepts, Inc. 2010). The area grew particularly fast since 2000 in terms of both percentage growth and numeric growth – the Raleigh-Cary Metropolitan Statistical Area (MSA) was the fourth fastest growing MSA in the country by percentage between 2000 and 2009.

In 2010, Chapel Hill's population stood at approximately 56,000 residents with a projected population growth to approximately 82,000 residents by 2035 (Town of Chapel Hill 2007, 3.4). This population fluctuates during certain times of the year with the influx of over 29,000 undergraduate and graduate students (full-time and part-time). Thousands of commuters also flow into Chapel Hill daily to work at UNC-Chapel Hill, UNC Hospitals, and other businesses

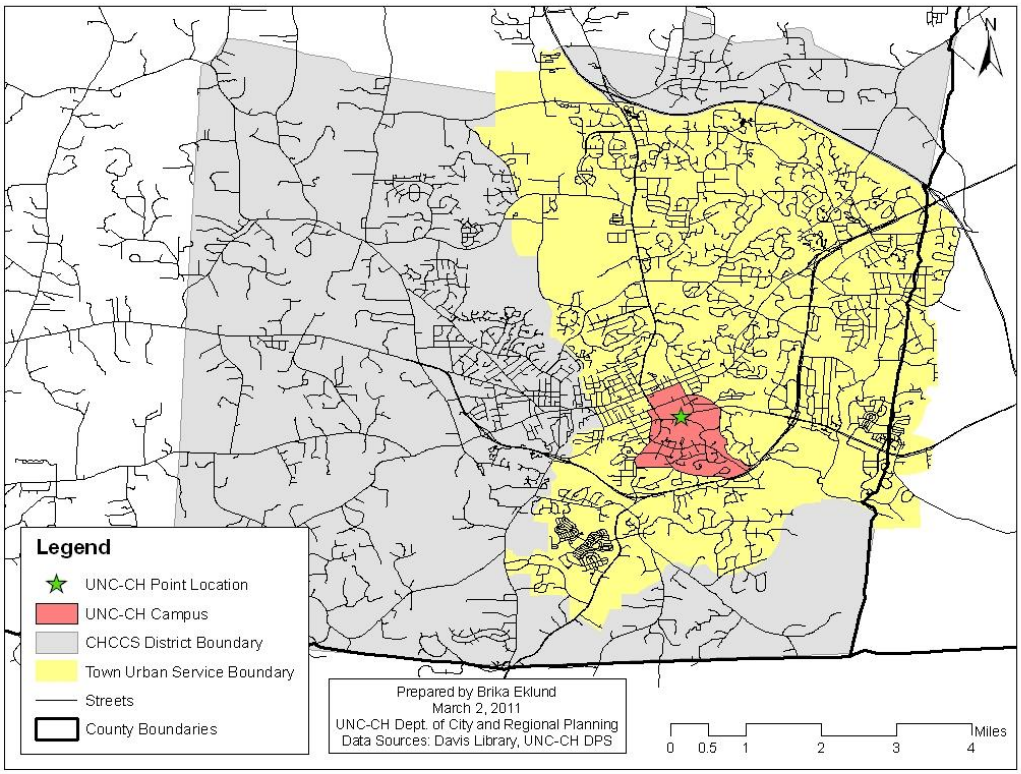
and organizations with town limits. Figure 1 shows the location of UNC-Chapel Hill within the state, as well as highlights the six counties from which 96% of the UNC-Chapel Hill and UNC Hospital employees surveyed in 2009 reside. The analysis conducted in Chapter 8 focuses on the individual, household, and neighborhood characteristics of employees living in this six-county study area.

Figure 1: Employee Residence Study Area – Six-County Region in Piedmont North Carolina



Within Chapel Hill itself, additional boundaries exist that are relevant to the discussion of affordable housing for employee populations. Figure 2 shows the Town's urban service boundary limits (described further in Chapter 4), with an area slightly larger than that of the area within the corporate limits at approximately 21.3 square miles. Portions of the Town overlap into Durham County; however, the majority of the town remains in Orange County. The Chapel Hill-Carrboro City Schools (CHCCS) district extends outward into Orange County covering approximately 36 square miles. Orange County Public Schools serves the remainder of the county population to the north and west, with additional schools sited in and around Hillsborough, North Carolina.

Figure 2: Relevant Boundaries Within and Around Chapel Hill, N.C.



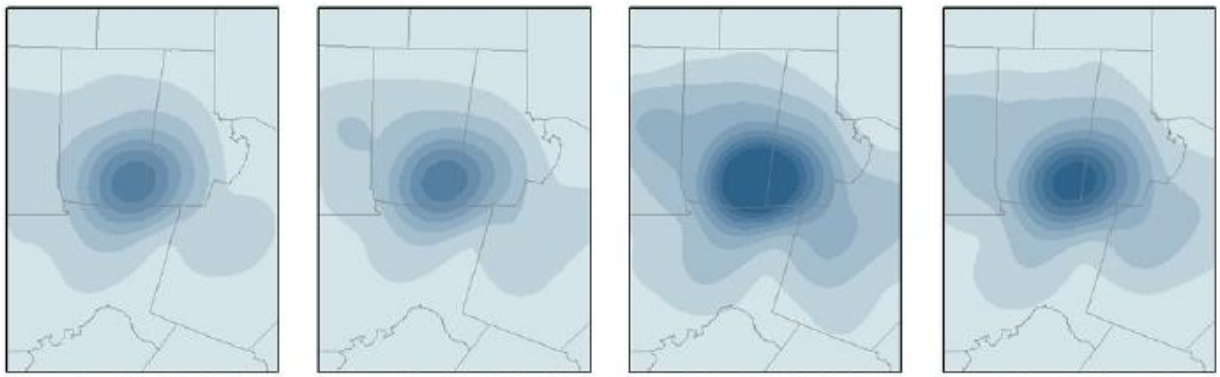
2.2 Housing Decentralization

In Chapel Hill, UNC-Chapel Hill and UNC Hospitals are fixed-location institutions whose employees live in an expanding geography. This seemingly expansive geography, however, interacts with established boundaries described above by either limiting or opening up additional housing options. Employees contend with the tradeoffs associated with the available choices.

In spring 2010, the transportation specialization workshop at the UNC-Chapel Hill Department of City and Regional Planning (DCRP), led by Dr. Daniel Rodríguez, explored the transportation patterns of UNC-Chapel Hill employees for the workshop's final product, "Examining the Changing Commute to UNC-Chapel Hill." Supplemental information to their workshop findings highlighted the expanding residential geography of employees. As Figure 3 demonstrates, the home location of UNC-Chapel Hill employees has spread outward from Chapel Hill between 1997 and 2009. These samples demonstrate that employees have moved away from Chapel Hill over time and that there is some driving force, or a combination of forces, influencing this

pattern. For the same 1997 to 2009 time period, Figure 4 represents the home location of all surveyed UNC-Chapel Hill employees by city or town. While Chapel Hill addresses still produce over one-quarter of UNC-Chapel Hill employed households, the proportion is steadily decreasing. Indeed, the proportion of employees commuting from other municipalities has steadily increased over the past dozen years.

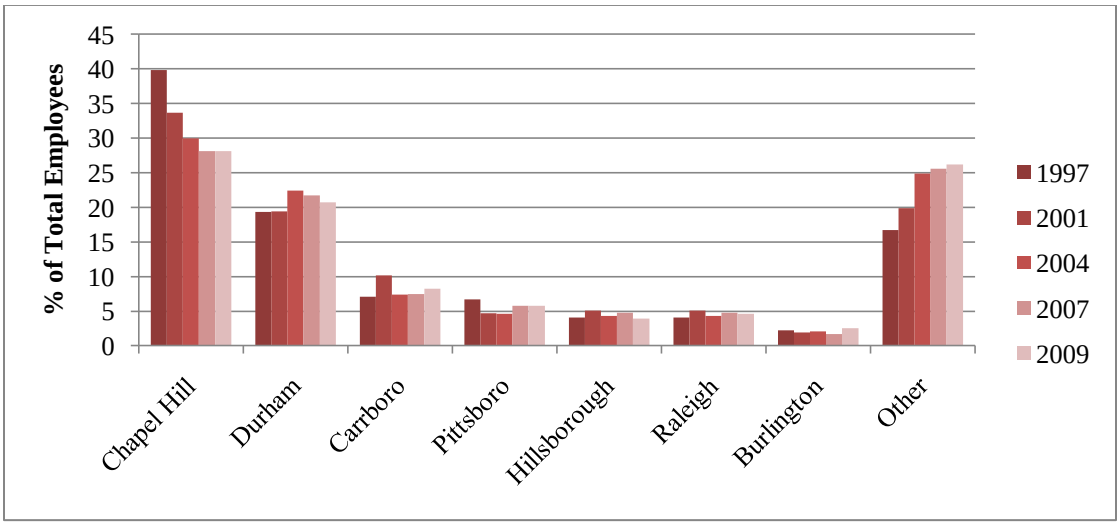
Figure 3: Home Location of All Surveyed UNC-Chapel Hill Employees, 1997 – 2009



1997	2001	2007	2009
n = 682	n = 695	n = 1705	n = 1191

Source: DCRP Spring 2010 Transportation Workshop "Longitudinal Analysis," p. 46
Density analysis is determined by the "employee density over time using nearest geocoded intersection."

Figure 4: Percent of UNC-Chapel Hill Employees Living in Various Towns/Cities, 1997 – 2009



Source: Author's time series representation of data tabulated in DCRP Spring 2010 Transportation Workshop "Longitudinal Analysis," p. 41

2.3 University Employer-Assisted Housing

Continued decentralization of housing away from employment centers has prompted numerous university-based communities including Chapel Hill to explore options for greater quantities of affordable housing in proximity to jobs. These universities easily think of themselves as employers, but often must also embrace the role of "urban developer" to successfully fulfill their primary role and capitalize upon their economic impact in communities for the purposes of revitalization (Perry and Wiewel 2005, ICIC 2002). One byproduct from this process is the development of "university employer-assisted housing" whereby a university becomes the development and/or management entity of employee (faculty and/or staff) housing.[1]

Leaders from UNC-Chapel Hill and the Town recognize the opportunities that each may have to address the affordable housing shortage through real estate development; each has commissioned studies (see Chapter 5) to better understand the existing information and available options. The research presented here enters into this ongoing process because the existing studies have not answered a particular question posed by Gordon Merklein, Director of Real Estate Development for UNC-Chapel Hill, in December 2010 – *why do employees live in other communities and would they live within Chapel Hill town limits even if the opportunity was provided?* Limited housing supply and the complementary high prices for existing units as addressed by previous studies undoubtedly influence residential location choice, but what other factors might correspond with where university employees live? If other factors are influential, how can UNC-Chapel Hill think about how and where to construct its own potential future employee housing developments more holistically to address these preferences?

[1] For a survey of 38 university employer-assisted housing programs, see Hoereth et al. 2007.

Chapter 3 – Literature Review

The theoretical framework required to address questions of residential location choice determinants is supported by research from the fields of urban planning, urban economics, and public policy. This chapter highlights three relevant areas of research in greater detail: (1) the spatial mismatch hypothesis; (2) residential location choice theory; and (3) the impacts of inversely correlated transportation and housing costs.[2] Although information within each field overlaps in the discussion of affordable housing, this chapter discusses each separately because of the multiple other areas (transportation and land use policy, persistent racial prejudice, varied patterns of wealth creation) to which each may also be applied.

3.1 Spatial Mismatch Hypothesis

In the housing field, "spatial mismatch" identifies the physical difference between the location of employment centers and the location of housing for the corresponding employees. A large body of the spatial mismatch research focuses on decentralization of employment and industry, as opposed to housing decentralization alone (e.g. Glaeser and Kahn 2001). For the purposes of this study, the latter is more relevant as UNC-Chapel Hill and UNC Hospitals are largely fixed-location employment centers within Chapel Hill town limits.

Spatial mismatch literature emerged in the 1960s with theories on the interplay between housing and employment in metropolitan areas. Following the landmark research by John Kain (1968), numerous studies investigated how the geographic isolation of African-Americans in central cities and evolving suburbanization led to disparities employment access and household wealth creation (Kasarda 1990, Massey and Denton 1985, 1993). Some research supported Kain's initial arguments, while others dismissed the hypothesis, claiming that "race, not space, remains

[2] Two additional concepts are generally accepted and do not require extensive literature review for the purposes of this study. First, the nuanced redefinition of affordable housing as "workforce" housing is both strategic and necessary. Advocacy groups have redefined affordable housing to demonstrate that the housing crisis does not impact only low-income residents who may be misperceived as low income because of laziness, poor life choices, or other controllable traits. Rather, housing issues affect even full-time working adults with families. Some organizations, such as the Urban Land Institute's Ronald Terwilliger Center for Workforce Housing, have placed a specific income definition on this group. Second, there is a body of literature that focuses on the university as an "urban developer." The underlying concept that UNC-Chapel Hill would consider being an urban developer is taken as a given in this study; for more information on the driving factors for universities to engage in urban (re)development, see Perry and Wiewel (eds.) 2005.

the key explanatory variable" (as quoted in Kain 1992, 375). Kain himself (1992) succinctly identifies multiple counter studies and provides rebuttals on why the spatial mismatch hypothesis is a necessary consideration in urban economics, despite a few more recent claims that while "the Kain emphasis on housing market discrimination as the source of [racial] segregation may have been startling in its day, [it] carries less force in the 21st century" (Glaeser et al. 2004, 75).

The spatial mismatch hypothesis fostered research across urban studies' fields, including public health, transportation, and education. One specific line of research relevant to this study reframes the discussion of *racial* segregation to *socioeconomic* separation of households. While there is a clear and uncomforting correlation between race and poverty in the United States (Massey and Denton 1993), variations in household economic status can be an illuminating characteristic through which to productively explore housing differences. Some research discusses socioeconomic differences in the context of race (St. John and Clymer 2000), while others focus exclusively on the former characteristic of economic status. Studies demonstrate that socioeconomic segregation is more prevalent in communities with restrictions on density (Pendall 2000, Rothwell and Massey 2010), inadequate public transit options in low-income communities (Glaeser et al. 2008), and physical limitations, such as mountains and waterways, that result in development patterns which generate negative externalities (Rohe et al. 2010).

3.2 Residential Location Choice

There are two components of the spatial mismatch hypothesis – the location of the employer and the location of the employee. Location choice research on the former is irrelevant to this study, as UNC-Chapel Hill's location was chosen over two hundred years ago for reasons other than modern economic strategy. On the other hand, research on residential location choice is critical.[3] This study does not replicate the complicated quantitative models that predict housing location choice. The review in this section will focus on the *theory* behind these studies that strive to model residential choice location based on individual and neighborhood characteristics. However, should future researchers wish to recreate the analyses conducted in Chapters 8 and 9 below, these robust studies would be invaluable to that endeavor.

[3] Some studies explore the interaction between residential and workplace choices. See Waddell et al. 2007.

Residential location choice is inherently complicated to measure or predict. Early studies of residential location choice emerged from the monocentric (having a single center point) model of the relationship between housing and employment opportunities. According to Waddell (1997), residential and employment location choice is part of the larger field of urban economics that unfolded into the monocentric model of the city beginning with the work of William Alonso, Richard F. Muth and Edwin S. Mills in the early to mid-1960s.[4] Because monocentric models require the researcher to make assumptions that "reduce significantly their theoretical and empirical applicability," researchers developed gravity density, discrete choice theory, and multinomial logit models to more realistically estimate residential location choice. The field of research exploded from there; the relatively recent addition of computer modeling techniques in the last two decades enables interactive modeling simulation programs.[5]

Of the many applications of residential location choice models, Wachter and Megbolugbe (1992) focus on persistent racial and ethnic disparities in homeownership levels across communities. In addition to their own findings, the authors summarize a study by Turner and O'Neal (1986) that categorized independent variables that affect housing location choice into five categories: (1) income and wealth; (2) life-cycle status; (3) race and ethnicity; (4) price and other market factors; and (5) location and neighborhood attributes.[6] With substantive data, these factors will help predict individual (not aggregated population) housing choices. It is this concentration on individual housing choices and the independent variables that may influence such choices that is the focus of this study.

Guo and Bhat (undated) use similar independent variables as this study to test for residential housing preferences. Specifically, Guo and Bhat include school quality measurements into their multinomial logit model for residential choice for residents of the Dallas-Fort Worth area. In their review of previous studies dating back to 1989, school quality had not previously been considered in residential location choice, even though this characteristic is one of the most important in residential location choice decisions by families with children. School quality is a critical factor in housing location choice for families and will impact housing prices (Black 1999,

[4] For a detailed review of the early monocentric (and other) spatial models, see Waddell 1997.
[5] See Pagliara and Wilson 2010 for a helpful summary of relevant computer simulation modeling programs.
[6] These five categories are used to classify variables in Chapter 8 below.

Fischer 2001, Bayer et al. 2007), and it is strongly at play in Chapel Hill (discussed further below) where school quality and housing prices are likely interlinked.

It is also important to note that inherent in housing choice is the ability to choose *not* to live or relocate somewhere, even if income or other variables are not constraining factors. Rohe et al. (2010) found that if given the preference to move closer to an urban center with more affordable housing options in Asheville, North Carolina, 62% of those surveyed would either relocate or would be willing to consider moving closer to employment opportunities.[7] Almost one-third of remaining survey respondents was not willing to consider relocation. Despite the financial benefits that may be associated with relocation (e.g. lower transportation costs), there are numerous other preferences such as cultural, family, and historical attachments that tie individuals and families to their housing locations.

3.3 Transportation and Housing Costs

A side effect to living further from work is the higher transportation costs associated with longer commutes. While traditional bid-rent models suggest that land is cheaper further away from employment centers, thus implying greater affordability in land and housing prices, this is no longer valid in an era of regionalism and rising energy prices. The growing realization that transportation costs significantly impact household economic well-being has stimulated broad discussion of the links between housing location and access to transportation. In particular, the Urban Land Institute's (ULI) Terwilliger Center for Workforce Housing researches the specific housing and transportation cost burdens in some of the most high-demand urban centers, such as Boston (ULI 2010), San Francisco (ULI 2009a), and Washington, D.C. (ULI 2009b). In each case, the steep price of housing and commuting costs strongly impacted household budgets and starkly altered the concept of "affordability" in these communities.

Because of the spatial mismatch between housing and employment, employees are commuting longer distances, thus wasting valuable time and expending resources inefficiently (Roberto 2008). According to the 2008 Consumer Expenditure Survey (CES) of the U.S. Bureau of Labor

[7] Most of the survey respondents in Rohe et al. (2010) were members of households earning $60,000 or less and the results for this population are reported above. For those households reporting more than $60,000 in household income, less than 50% would either move closer to work or consider moving closer to work.

Statistics, housing and transportation costs together accounted for at least 50% of average annual expenditures amongst residents of central city and other urban areas.[8] Although many low- to middle-income families "drive 'til they qualify" in search of affordable housing outside city limits, the Center for Housing Policy reports that after commuting distances exceed 12 to 15 miles from employment centers, the higher transportation costs override the housing savings (Lipman 2005). This reality will likely be further exacerbated in the future as energy costs increase and urban populations swell, putting greater strain on central city land and housing availability.

Longer commuting distances do not affect the budgets of employees alone. Companies and institutions also feel the effects of high transportation costs on their bottom line through less employee productivity and higher employee turnover. Rohe et al. (2010, 23-24) calculated the cost of employee turnover in Buncombe County, North Carolina. The annual cost for employee turnover across seven crucial employment sectors is approximately $409.3 million.[9] If even only a portion of that turnover is the result of long commutes and associated high costs, Buncombe County industries (and others like them around the country) face significant costs from the lack of affordable, accessible housing options for its workforce.

[8] A 2008 ACS consumer expenditure survey found that households spend 50.6% (central city) and 51.2% (other urban) of income on housing (including rent, utilities, and maintenance) and transportation costs alone.
[9] The seven sectors studied are construction, manufacturing, professional and business, education and health, leisure and hospitality, law enforcement officers, and teachers.

Chapter 4 – The Context for Affordable Housing in Chapel Hill

Five characteristics specifically relevant to Chapel Hill – *centralized employment, high incomes, high housing prices, an urban growth boundary*, and *quality public schools* – increase the challenges in providing affordable housing options for workforce populations in town limits. While these factors are not mutually exclusive, each is explored separately to further illustrate the context in which UNC-Chapel Hill finds itself in the pursuit of workforce housing options for its employees. Few towns of Chapel Hill's size can boast all of these characteristics, thus further emphasizing the unique challenges and opportunities that institutions face in providing workforce housing.

4.1 University as the Primary Employer

In many cities, decentralized housing patterns such as those described above correspond with decentralized employment opportunities. While the Triangle as a region offers numerous employment options that influence residential location choices of two-worker households, employees of organizations or companies within Chapel Hill have far fewer options. As shown in Table 1, UNC-Chapel Hill and UNC Hospitals are currently the top two employers within Orange County and employee numbers continue to grow. From 1990 to 2007, university staff numbers increased from 8,289 to 11,036, while UNC Hospital staff increased from 4,203 to 6,475 (Town of Chapel Hill 2007, 1.2). These represent 33% and 54% increases, respectively, over less than twenty years.

Table 1: Top Ten Employers in Orange County by Size (2007)

Organization/Company	Industry
UNC-Chapel Hill	University
UNC Health Care	Hospital
Chapel Hill-Carrboro City Schools	Education
Blue Cross Blue Shield	Health/Medical Insurer
Orange County Schools	Education
Orange County	Local Government
Town of Chapel Hill	Local Government
General Electric Company, Inc.	Utility Provider
Harris Teeter, Inc.	Supermarket
Sports Endeavors, Inc.	Equipment Manufacturer

Source: Adapted from Town of Chapel Hill 2007, 3.13.

As of August 2010, UNC-Chapel Hill employees totaled 12,086 (both full-time and part-time employees). Full-time faculty account for 27% of the workforce, while full-time administrative and professional staff represents 67% of the workforce. 76% of employees are white/Caucasian and 13% are black/African-American. 55% are female, and 45% are male (Office of Human Resources 2010). As of 2011, UNC Hospitals employs 7,553 persons who reside in one of the six counties highlighted in Figure 1. This represents almost 94% of its workforce; almost one-quarter of that workforce (23.9%) both lives and works in Orange County ("UNC Health Care's Impact" 2011). With this diverse employee base, each institution must take special considerations in its approach to any workforce housing opportunities.

4.2 Higher Household Incomes

In addition to the relatively infrequent situation of centralized employment in Chapel Hill, the Town also boasts some of the highest family and household incomes in North Carolina. This study utilizes *household* income in the following analysis and Table 2 shows comparisons of household income across geographies. Historical household income is not available for Chapel Hill; however, based on other income definitions, the Town has higher incomes than Orange County, North Carolina, or the nation as a whole.[10] As Chapel Hill is a part of the Raleigh-Durham region, it is evident that this area's median household income is comparable to, if not higher than, the median household income for the nation. Additionally, Chapel Hill's median household income is consistently higher than that of Orange County and North Carolina.

[10] Area median *family* income is not used in this analysis because survey respondents reported household, not family, income by income range. It is impossible to accurately translate reported household income ranges to family income without specific familial composition information being provided in the survey as well. Table 2 does not show household incomes because they were not available for the geographies shown here for comparison purposes. The following chapter outlines the methodology for selecting a median household income for Chapel Hill that is used in the remainder of the analysis. Chapel Hill has the highest median family income of any geography in the area based on Town planning department estimations. 2006 estimated median family income for a family of four is $92,106, with Orange County at $74,623, North Carolina at $47,100, and the U.S. at $59,600 (Town of Chapel Hill 2007, 2.5).

Table 2: Median Household Income (MHI) in Selected Geographies, 1970 – 2006

	1970	% U.S. MHI	1980	% U.S. MHI	1990	% U.S. MHI	2000	% U.S. MHI	2006	% U.S. MHI
Orange County	n/a	n/a	n/a	n/a	n/a	n/a	$42,372	84%	$53,558	90%
Raleigh-Durham MSA	n/a	n/a	n/a	n/a	n/a	n/a	$53,184	106%	$61,700	104%
NC (non-metro)	n/a	n/a	$16,792	80%	$31,548	96%	$48,000	96%	$47,100	79%
U.S.	n/a	n/a	$21,023	100%	$35,224	100%	$50,200	100%	$59,600	100%

Source: Adapted from Town of Chapel Hill 2007.

4.3 High Housing Prices

Not only are median incomes higher than average, but so are median home values. Cost is the most critical indicator of affordability in both renter- and owner-occupied housing, and high housing costs are pervasive in Chapel Hill. The average sales prices of homes as shown in Table 3 are for aggregated single-family detached housing, townhouses, and condominiums prices for resale and new properties as listed in Triangle Multiple Listing Services in Chapel Hill and comparable geographies (does not include housing for-sale by owner).[11] Although sales prices increased throughout the region during this time, Chapel Hill sales prices and percent increase (2000 to 2006) were higher than all comparable geographies as early as 2000. Table 4 shows the price range of houses sold in 2006 during the height of the recent housing boom. In Chapel Hill, a significant portion of homes sold in the higher price brackets – an astonishing 64.7% sold for more than $250,000. Even with strong population growth and demand in Durham and Wake counties, as noted by the high quantities of sales, the proportion of homes selling within this highest price bracket was approximately half that (or less) than in Chapel Hill. As stated by the 2007 Data Book, "…between 1998 and 2006, the proportion of sales in the upper middle ranges rose and the proportion in the lower middle range fell. This indicates a rise in house prices and a decrease in the availability of houses at the lower [price] levels" (Town of Chapel Hill 2007, 4.2).

[11] For the purposes of the Triangle Multiple Listing Services database, all "Chapel Hill" properties are those listed within the zip codes 27514, 27516, and 27517, which may fall within Carrboro, Orange County, Durham County, or Chatham County.

Table 3: Average Housing Sales Prices, 1995 – 2006

Year	Chapel Hill	Orange County	Durham County	Wake County	Total Avg. Sales Price
1995	n/a	$171,038	$123,266	$158,431	$150,912
1997	n/a	$197,071	$138,876	$170,170	$168,706
1999	n/a	$218,875	$146,795	$187,217	$184,296
2000	$262,162	$235,633	$156,568	$199,362	$195,004
2001	$278,012	$249,226	$162,913	$204,374	$201,322
2002	$299,358	$261,895	$163,462	$212,567	$208,020
2003	$320,913	$280,592	$173,844	$212,382	$222,273
2004	$342,426	$298,883	$171,071	$221,903	$230,619
2005	$370,924	$320,489	$181,162	$235,615	$245,756
1st half, 2006	$387,451	$318,899	$189,316	$249,944	$252,720
Percent Increase (2000-2006)	47.7%	35.3%	20.9%	25.4%	29.6%

Source: Adapted from Town of Chapel Hill 2007, 4.4.

Table 4: Price Range of Houses Sold, 2006

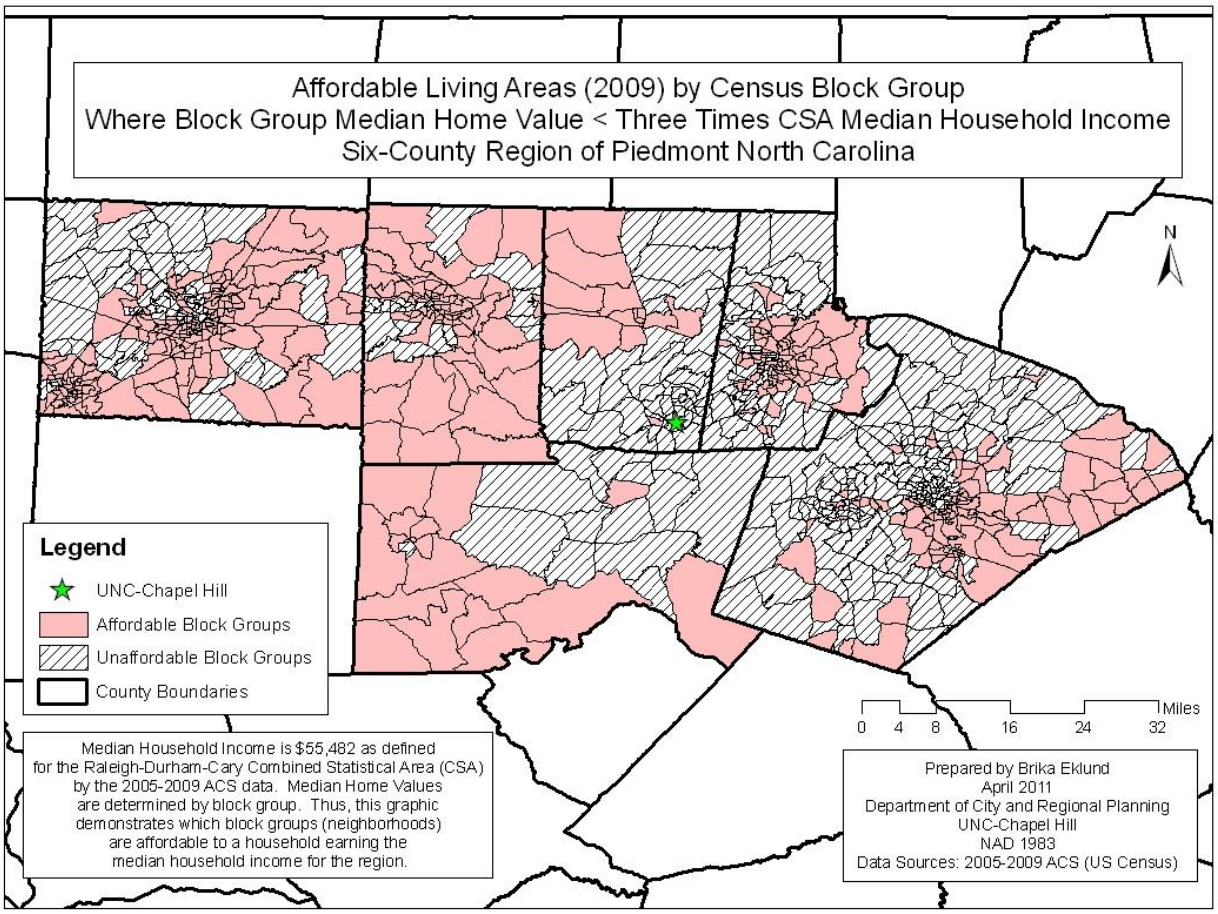
Price Range	Chapel Hill		Orange County		Durham County		Wake County	
	Units Sold	% of Total	Units Sold	% of Total	Units Sold	% of Total	Units Sold	% of Total
Under $79,999	26	1.9%	69	3.8%	488	10.2%	631	3.0%
$80,000 - $119,999	62	4.6%	138	7.7%	604	12.7%	2,170	10.4%
$120,000 - $159,999	124	9.2%	246	13.7%	1,154	24.2%	4,192	20.1%
$160,000 - $199,999	135	10.0%	204	11.4%	993	20.8%	3,529	16.9%
$200,000 - $249,999	129	9.6%	215	12.0%	616	12.9%	2,881	13.8%
Greater than $250,000	872	64.7%	923	51.4%	915	19.2%	7,487	35.8%
Total	1,348	100.0%	1,795	100.0%	4,770	100.0%	20,980	100.0%

Source: Town of Chapel Hill 2007, 4.5

In most communities, home sales prices have plummeted with the recent economic recession. In Chapel Hill, prices are instead increasing less rapidly and the market remains strong – the average sales price for a home was $458,445 with 3,206 homes sold between 2000 and 2010 (Development Concepts, Inc. 2010, 30). With this average home price significantly higher than any of the trending seen from 2000 to 2006 in Table 3, home prices continued to rise during the last five years in Chapel Hill.

The higher incomes and housing prices as seen in Chapel Hill do not translate to all neighborhoods within the Triangle region. Combining income and housing price data, Figure 5 demonstrates the "affordable" and "unaffordable" areas (by 2000 Census block group) surrounding Chapel Hill using a standard measure of neighborhood affordability.[12] Most of the neighborhoods within an eight- to ten-mile radius around Chapel Hill are unaffordable, while as distance increases, the number of affordable neighborhoods increase.

Figure 5: Affordable and Unaffordable Block Groups in Six-County Region (2009)



[12] The affordability standard used here is that "affordable" block groups have a median home value that is less than three times the Raleigh-Durham-Cary CSA median household income ($55,482). "Unaffordable" block groups have a median home value that is greater than three times the area (block group) median household income.

4.4 Urban Growth Boundary

The high costs for housing can be traced, in part, to the growth restrictions that the Town's elected officials initiated over thirty years ago. The urban growth (services) boundary (see Figure 2), also called the Town's "rural buffer," was established following a decade of disagreement between Orange County and Chapel Hill over the granting of extraterritorial jurisdiction rights to the Town. Chapel Hill requested the right to control development along its urbanizing edges to protect watershed quality as well as its citizens' preferred quality of life, and Orange County refused. Following a proposal for a large 177-unit subdivision development in Carrboro, the three local governments established planning focus groups and eventually instituted an urban growth boundary in 1987 (Godschalk 1992). Staff and elected members of local governments drove this process – UNC-Chapel Hill was not involved and took no position (Godschalk 2011).

Over the past two decades, the buffer and corresponding consolidation of municipal services within it have undoubtedly influenced local development patterns through individual parcel decision-making and comprehensive planning efforts. In particular, the decision against extending municipal services, such as water and sewer lines, outside of the urban growth boundary to greenfield (untouched land) development has very likely increased land prices within town limits, thus driving out the opportunities for affordable housing development.[13]

4.5 Quality Public Schools

Lastly, the quality of the local public school system significantly impacts housing values within town limits. Chapel Hill-Carrboro City Schools (CHCCS) consistently rank among the highest non-charter public schools in the country. This higher quality does not come without a price – Chapel Hill and Carrboro residents vote to levy additional taxes upon themselves to fund the school system at a higher standard. This additional tax increases the cost basis for owning property in Chapel Hill, thus pricing out additional owners and renters (the latter of which likely pay the fee through pass-through increases in rent).

[13] In recognition of the increasing land prices in Chapel Hill as a result of the urban services boundary, and the resulting lack of affordable housing, the Town did implement a voluntary inclusionary housing ordinance (which became mandatory in 2010) requiring that any developments of four units or more include 15% affordable units.

In March 2005, Grumet et al. reported that CHCCS ranked fifth in North Carolina for per pupil expenditures and first in the state for local contributions to per pupil expenditures. This financial commitment has contributed to higher rankings for the school system. In 2010, CHCCS students earned the highest SAT scores in the state (Lafever 2010). With higher quality public schools comes increased pressure for development – it is widely accepted that better public schools increase both housing demand and housing prices, though the magnitude of these effects are still under debate. Black (1999) found that a 5% increase in test scores increased housing prices by 2.5%, while Bayer et al. (2007) also found increases in the quality of public schools (among other variables) increase housing prices in the same neighborhood. These studies demonstrate that there is a significant effect and that community investment in public education further impacts the residential development demands, driving housing prices up to less affordable ranges.

Chapter 5 – Review of Local Affordable Housing Studies

Many involved decision makers recognize the special circumstances facing potential renters or homeowners within Chapel Hill. Departments within both UNC-Chapel Hill and the Town have commissioned studies to investigate existing housing market supply and demand. The expressed impetus for each has varied, ranging from concern over the lack of affordable housing options to market studies to inform real estate development programs on university-owned property. This chapter briefly discusses relevant sections of two studies for UNC-Chapel Hill and two studies for the Town. This study does not seek to replicate the work that has already been conducted, but rather contribute to the ongoing conversations supported by this past research.

5.1 Research Conducted for UNC-Chapel Hill

UNC-Chapel Hill commissioned two studies to explore the workforce housing needs of the faculty and staff. Each study is available in its entirety from its cited source; for the purposes of this research, brief summaries of each are outlined in descending chronological order with additional key facts provided in bullet form.

Study #1: "Workforce Housing Preliminary Analysis" (February 2010)

In September 2009, the firm Brailsford & Dunlavey (B & D) conducted a Preliminary Workforce Housing Analysis commissioned by UNC-Chapel Hill. The goal of the analysis was to "analyze the current residential housing market in the Chapel Hill area, to examine common practices of providing workforce housing at UNC's peer institutions and other comparable universities, and to review the potential development of a university community called Carolina Commons on undeveloped land owned by UNC" (Brailsford & Dunlavey 2010, i). The statistical results provided in this study are meant to complement these recent findings on workforce housing options on university-owned property.[14]

B & D found that most universities utilize one of the following four structures to provide workforce housing assistance to their faculty and staff: *formal referral program* (i.e. an informational resource center based at the university and the most common type of support),

[14] For a copy of the study, please contact Gordon Merklein, Director of Real Estate for UNC-Chapel Hill, to determine whether one is available for public use.

financial assistance program (i.e. mortgage assistance), *rental program* (i.e. university-managed rental units), and/or a *university community* (i.e. university-sponsored for-sale housing). B & D conclude that there are multiple structures that may work for UNC-Chapel Hill and the firm outlines five "decision points" and key questions that decision-makers must answer before moving forward with housing at the three likely sites already owned by UNC-Chapel Hill: Carolina North, Carolina Commons, and University Square.

The B & D study provides two additional pieces of information: relevant case studies on comparable universities and their related employee housing programs and staff surveys and interviews on residential preferences. For example, B & D researched the structure of comparable university programs including Duke University (homeownership program within Trinity Heights), Princeton University (financial assistance and rental program), University of Chicago (financial assistance and rental program), and Stanford University (financial assistance, rental program, and ground lease program).

B & D also interviewed and surveyed faculty and staff from UNC-Chapel Hill (not UNC Hospitals). Results included the following:

- Total cost is main driver of housing choice location, followed in order of importance by safety and security, proximity to campus, quiet/secluded neighborhood, proximity of retail, and proximity to available parking;[15]
- The reported downsides to an all-university community (i.e. Carolina Commons) include the lack of privacy, being surrounded by colleagues during off-work hours, and property resale restrictions;
- The housing tenure of survey respondents is as follows – 51% respondents own a detached house, 11% own an attached house, 4% own a condo, 6% rent a detached house, 4% rent an attached house, and 20% rent an apartment (4% other); and,
- The type of relocation support received by faculty and staff from UNC-Chapel Hill included the following – 2% temporary/transitional housing, 12% resources and information about the housing market, and 29% financial support to cover relocation expenses. Over half of respondents (57%) received no relocation support.

[15] It is interesting to note that school quality was not an option for indicating housing preferences.

Study #2: "Mixed-Use Market Analysis at 123 West Franklin Street: Chapel Hill, North Carolina" (August 2009)

The market research firm RCLCO completed a study for Cousins Properties, the firm selected to redevelop University Square near the intersection of West Franklin Street and Columbia Street in downtown Chapel Hill. Based on its findings, RCLCO recommends a particular development program for the site, including office space, retail, student housing, market rate rental, and for-sale attached units. Specifically, the analysis of employment growth trends and existing supply lead RCLCO to recommend greater concentrations of rental units within the development rather than large numbers of for-sale units. With regards to affordable housing in particular, RCLCO notes what 87% of new product in the study area is priced over $375,000 while only 13% of existing demand is for units of this price range. In total, 69% of demand is for housing priced at between $125,000 and $375,000, resulting in an existing "market gap" in housing supply at these prices ranges (RCLCO 2009, 48).

5.2 Research Conducted for the Town of Chapel Hill

Since 2007, the Town has commissioned two studies relevant to this analysis on workforce housing for UNC-Chapel Hill and UNC Hospitals employees. The first source analyzes the workforce housing requirements prompted by new residential construction. The second study originated from the Office of Economic Development but focuses specifically on the Town's housing market.

Study #1: "Calculating the Need for Affordable Housing in Chapel Hill Generated by New Housing Construction" (May 2009)

In spring 2009, the graduate workshop for the UNC-Chapel Hill Department of City and Regional Planning (DCRP) housing specialization conducted research on the impacts that market-rate residential housing construction had on the total Chapel Hill housing market. Generated by Dr. Spencer Cowan at the Center for Urban and Regional Studies, the final report outlines the Town's continued affordable housing problems, ranging from high housing prices, to slow income growth, to the resulting affordability gap for both for-sale and rental housing. Dr. Cowan contributes further to the discussion by calculating the number of affordable housing units required for every one hundred market-rate units built within town limits: 18.4 homes are

required for all of the low-wage jobs generated by new home construction. Such jobs include construction workers, town department employees, and public school teachers. In 2010, this report was used by the Town Council to help pass a mandatory inclusionary zoning ordinance set at 15% affordable housing units in a development with four units or more.

Study #2: "Residential Market Study for the Town of Chapel Hill, N.C." (December 2010)

The Town of Chapel Hill's Office of Economic Development commissioned Development Concepts (DC), Inc. to investigate the current housing supply and demand within Town limits. The firm researched the quantity of for-sale and rental units for market-rate, affordable, and student households from June to December 2010. This research serves primarily to review demographic shifts over time and as a market study of the current housing supply and future housing demand within Town limits. The study concludes with the following summary of local housing needs (DC, Inc. 2010, 66):

- *For-Sale Housing:* Single-family units for households 100% to 175% AMI, units for family households that desire to be located with CHCCS district, and housing for single professionals;
- *Rental Housing:* Newly-constructed units that are more affordable, replacement units for existing rental units that are likely to be lost to redevelopment or sale, and market-rate units for downsizing households;
- *Workforce Housing:* Rental and for-sale units for households 80% to 120% AMI, and units for middle-income workforce priced out of the Chapel Hill market; and,
- *Low-Income Housing:* More units of public housing and replacement units for subsidized units that are likely to redevelop.

Of particular note, DCI notes that the largest housing needs are for families seeking affordable detached units and for single-person households. For the former, the study estimates that a two- to four-person household would require an annual income of $85,000 to $95,000 to purchase an average priced home within town limits. Highly-paid single-person households are also unlikely to be able to afford housing within town limits at affordable levels (DC, Inc. 2010, 64).

Chapter 6 – Research Questions

The research highlighted in Chapter 5 has investigated affordable housing issues in Chapel Hill, including market research of supply and demand indicators as well as the socioeconomic and policy implications of limited affordable housing options. This study seeks to contribute to this discussion with analyses of the residential location differences between workforce and unconstrained employees of UNC-Chapel Hill and UNC Hospitals. This information can be generalized to other universities and large hospital institutions considering the effects of limited available housing options for their workforce.

Specifically, this research paper seeks to address the following three questions:

- What are the differences in housing location patterns between current *workforce* and *unconstrained* households employed by UNC-Chapel Hill and UNC Hospitals?[16]
- For workforce and unconstrained households, what are the statistically significant *household* and *neighborhood characteristics* that correspond with each population's residential location choices?
- If household income did not factor in housing location preferences, what is the expected distance away from UNC-Chapel Hill that *future, non-resident, workforce household employees* would live if newly employed by either institution?

6.1 Definitions

The following analysis is founded on a differentiation between two household types in which UNC-Chapel Hill and UNC Hospital employees live – those with low and moderate incomes and those with higher incomes. Low- and moderate-income households, defined as "workforce" households in this study, are those earning approximately 60% to 120% of area median household income (AMHI), an income bracket defined most holistically by the ULI Terwilliger Center. Higher-income, or "unconstrained," households earn more than 200% AMHI for this analysis. These households are denoted as unconstrained based on the assumption that they have fewer (if any) income-constraining determinants of housing location choice.

[16] In this paper, "current" refers to employees working for UNC-Chapel Hill in 2009. This is the most recent set of survey data available for analysis from the UNC-Chapel Hill Department of Public Safety.

6.2 Primary Data Sources

Two primary sources provide all of the individual and household data used in this analysis. Neighborhood characteristics by block group are incorporated from the 2005-2009 Five-Year American Community Survey (ACS) released by the U.S. Census Bureau in December 2010.

Employee Travel Mode to Work Survey

Approximately every two years, the UNC-Chapel Hill Department of Public Safety (DPS) conducts a transportation mode choice survey of employees. While this survey focuses on transportation mode choices, there is additional individual and household information that may be used for other analyses.[17] Upon the author's signing of a data use agreement, DPS allowed Dr. Daniel Rodríguez to release survey responses of over 1,600 UNC-Chapel Hill and UNC Hospitals employees from 1991 to 2009. Only the data from 2009 is used in this study.

Employee Residential Location

In addition to the survey results, Dr. Rodríguez also released mapped geographical information systems (GIS) data for the home location of each surveyed employee. Each employee is mapped to its nearest intersection and this data are used to assign each employee to its relevant block group, and thus its neighborhood characteristics. Per the signed data use agreement, no individual point data are displayed in this analysis. Rather, all distribution maps are displayed using kernel density bubbles to protect the privacy of all employees.

[17] UNC-Chapel Hill DPS collects this information as part of its agreement with the Town of Chapel Hill regarding the former's financial contribution to the free public bus service.

Chapter 7 – Methodology

This chapter outlines the detailed methodology established for comparing the residential location choices of workforce and unconstrained households. The key steps included defining income limits, identifying the spatial distribution of workforce and unconstrained households, and selecting relevant variables for analysis.

7.1 Determining Area Median Household Income and Limits

A challenge in this analysis is determining whether to use median household or family income. As described in Chapter 4, the numbers for median income differ significantly based on the chosen definition (household or family) and geography. This analysis uses household income largely because household income, not family income, was reported in the surveys distributed to UNC-Chapel Hill employees. The 2005-2009 ACS data provides median household (and family) income data at the block group level. Rather than confine this analysis to a median household income within the block groups only in Chapel Hill, this analysis expands that definition slightly to capture some of the regional interactions as UNC-Chapel Hill is a regional employer. The Raleigh-Durham-Cary Combined Statistical Area (CSA) median household income is the best available regional estimate for 2009. The corresponding income limits based on the definition of workforce households as those earning approximately 60% to 120% area median household income and available survey data are outlined in Table 5:

Table 5: Available Income Definitions and Resulting Income Limits

Income Description	Relevant Income or % Boundary
Raleigh-Durham-Cary CSA Median HHI	$55,482
60% Area Median HHI	$33,289
120% Area Median HHI	$66,578
Available Lower End Bracket* - $35,001	63%
Available Upper End Bracket* - $75,000	135%
200% Area Median Income	$110,964
Available Unconstrained Bracket* - $120,001	216%

Source: 2005-2009 ACS (from http://www.census.gov).
*Note: The 2009 employee survey distributed by UNC-Chapel Hill DPS requested household income by range, not exact figures.

Because of the available survey data, the employees tested in this study have the following income ranges – workforce households earn between 63% and 135% AMHI, while unconstrained households earn more than 216% AMHI.

Before conducting regression analysis in Chapter 8, note the geographical distribution of surveyed employees working for either UNC-Chapel Hill or UNC Hospitals in 2009 (Figures 6 and 7). In the kernel density calculations, the radius parameters are set at 20,000 square miles to demonstrate the smooth, more generalized density distribution rather than clustered, specific cells with concentrated populations. Less unconstrained employees were surveyed; thus, the distribution is even less granulated at this radius. However, it is clear that workforce households are distributed in relatively high concentrations across more counties, including with a presence in Hillsborough, Alamance County, and throughout Durham County. Unconstrained households, on the other hand, are heavily concentrated around Chapel Hill and in Orange County with only a small presence in Durham (city) and southern Durham County.

Figure 6: Home Location (2009) of Workforce Household Employees

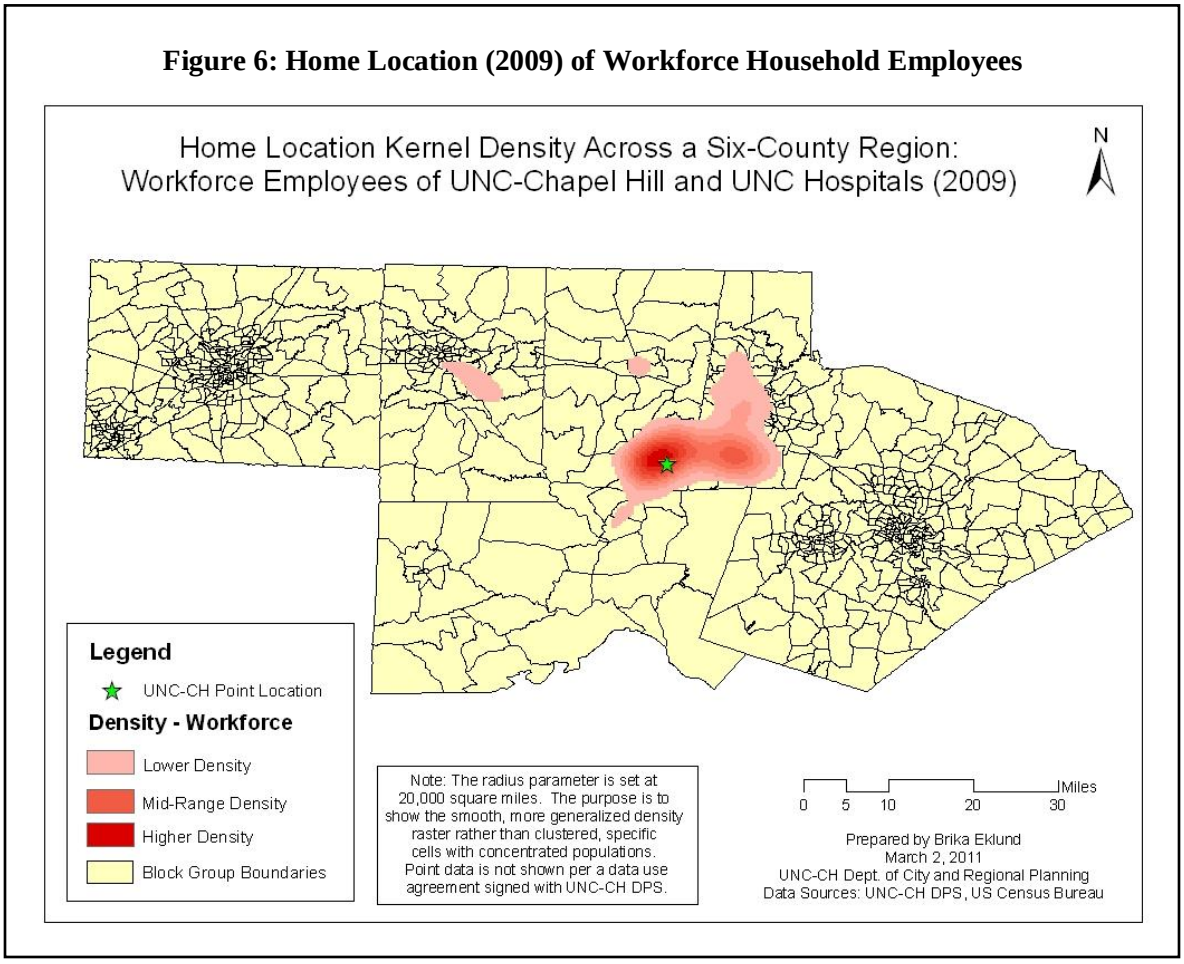
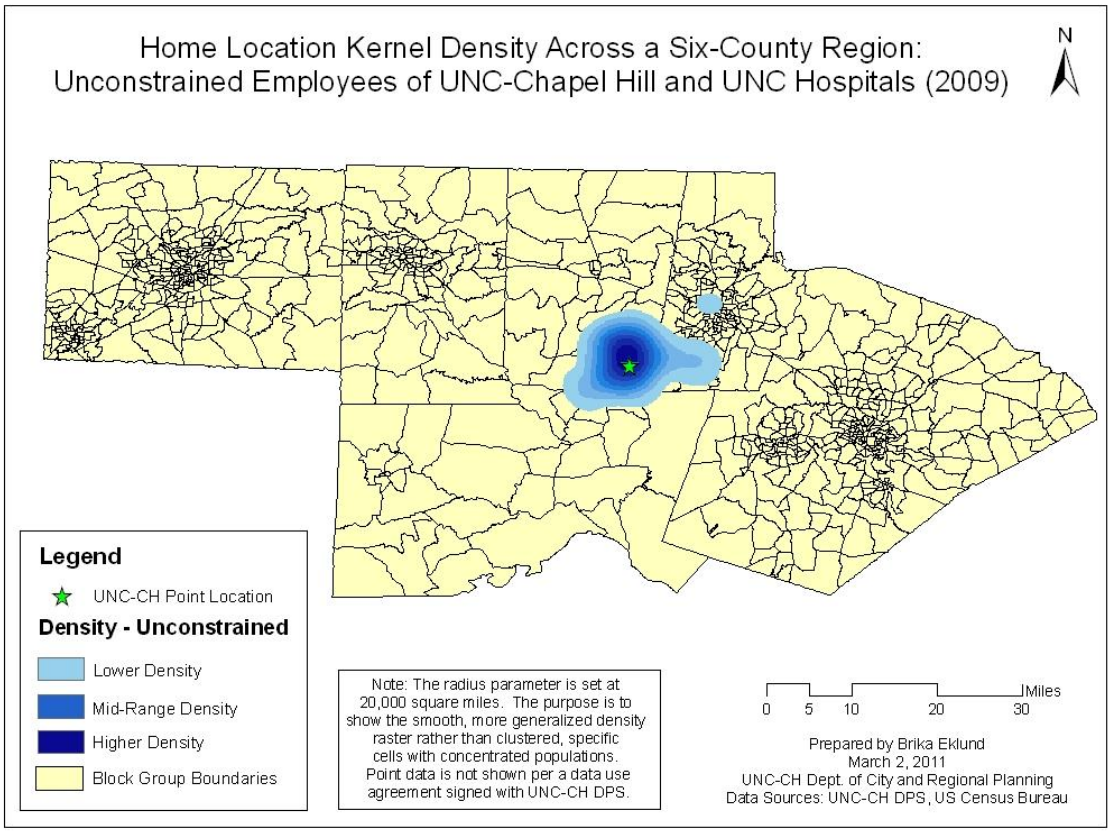


Figure 7: Home Location (2009) of Unconstrained Household Employees



7.2 Delineating Workforce Households by Employer

In addition to the workforce employees' income classification, their specific employer is important. While the residential patterns of UNC-Chapel Hill and UNC Hospital employees could be analyzed together, the two organizations are very different institutions with separate governing structures. In the hope that this analysis may prove useful to one or both organizations at some time in the future, the results are separated so that each employer may respond in the most appropriate way for their specific workforce population.

Table 6 provides a summary of the number of observations of each type of household and employer. Using the income definitions provided in Table 5 above, households are defined as either workforce or unconstrained. The survey also provided information on whether the respondent was employed by the "university" (full-time or part-time) or the "hospital" (full-time

or part-time).[18] Unfortunately, the 2009 survey did not capture many unconstrained households that work for UNC Hospitals. For the purposes of the analysis below, the unconstrained households are combined (n = 216) in order to test residential preferences using a larger sample size. Of all 623 survey respondents in 2009, approximately two-thirds are considered workforce households by the definitions outlined in this analysis and approximately three-quarters are employed by UNC-Chapel Hill.

Table 6: 2009 Survey Responses by Household Type and Employer (n = 623)

	UNC-Chapel Hill	UNC Hospitals	
Workforce HHs	283	124	*407 (65.3%)*
Unconstrained HHs	194	22	*216 (36.7%)*
	477 (76.6%)	*146 (23.4%)*	*623 (100%)**

*Note: The regression analyses in Chapter 6 were conducted based on these responses but the numbers do not mirror one another. When a response was unavailable, a "null" value of an empty cell was entered.

7.3 Selecting Neighborhood Demographic Data

Because of the limited household information available, this study relies on assigning each employee to his/her neighborhood based on the residential location. This is completed by assigning each employer to his/her block group as a proxy for neighborhood, defined by the 2000 U.S. Census. The demographic data used from each block group is from the 2005-2009 (Five-Year) American Community Survey, the new method of collecting and reporting demographic information from the U.S. Census.[19] The detailed five-year data are available for the first time at the block group level; thus, the demographic information incorporated into this analysis is the most recent available. When 2010 Decennial Census information is released, this study could be updated to include those even more exact figures. Demographic information was gathered for block groups within a six-county region including Alamance, Chatham, Durham, Guilford, Orange and Wake counties. Of the surveyed employees in 2009, 96% live in these six counties and this was deemed sufficient for this analysis to eliminate unnecessary outliers.

[18] Only employees responding as "full-time" are included in the analysis. The exclusion of part-time staff does not change the results substantially, as only 14 and four respondents, respectively, noted that they are part-time employees of the university and the hospitals.

[19] 2005-2009 ACS tract and block group level data were only available through the Summary 3 File at the time of analysis and had to be manually retrieved.

7.4 Identifying the Variables

The primary purpose of this study is to determine (1) how far away from UNC-Chapel Hill employees live and (2) what characteristics of their household or neighborhood may correspond to this residential location choice. The following chapter presents the descriptive analysis necessary to address the first issue and the regression with both dependent and independent variables. Table 7 summarizes each of the variables used in these calculations. The dependent variable – the distance in miles from UNC-Chapel Hill (*dist_m*) – is being tested and helps to answer the research questions by streamlining each employee's residential location so that it may be compared to others. This dependent variable – measured as the direct line distance between two points – is not an exact measurement of the distance traveled to work, as employees must use available roadways that rarely follow direct paths. However, this is a fairly precise and confident unit of measure based on regression comparisons.[20]

Table 7: Independent Variables Used in Analysis

	Type of Characteristic	Variable Name	Source
Independent Variables	**Individual/Household Characteristics[21]**		
	Family Type (Two-Worker HH)	*two_work*	Assumed *(see above)*
	Number of Children Age 0-5 Years	*child_05*	DPS Survey
	Number of Children Age 6-18 Years	*child_618*	DPS Survey
	Gender of Employee	*gender*	DPS Survey
	Age of Employee	*age*	DPS Survey
	Neighborhood Characteristics (by Block Group)		
	Population Density (by acre)	*popdens_09*	2005-2009 ACS
	Black/African Americans (%)	*popbl_per*	2005-2009 ACS
	Asian Residents (%)	*popas_per*	2005-2009 ACS
	Hispanic Residents (all races) (%)	*pophisp_per*	2005-2009 ACS
	Median Household Income	*med_hhi*	2005-2009 ACS
	Median Home Value	*med_value*	2005-2009 ACS
	Vacancy Rate (%)	*vac_rate*	2005-2009 ACS
	Owner-Occupied Housing Units (%)	*occowner_per*	2005-2009 ACS
	Education – More than College (% Total Pop)	*more_per_all*	2005-2009 ACS
	Housing Units – Single-Family Detached (%)	*units_1d_per*	2005-2009 ACS

[20] A quick regression analysis was conducted between the straight-line distance between residential location and UNC-Chapel Hill, and the response of each employee to the question "How far [in miles] is it from home to your workplace?" When compared, the correlation is very significant ($p > 0.000$; R-squared = .8005). This provides affirmation that straight-line distance, rather than reported distance, is a reasonable dependent variable. See Appendix 1 for specific response categories.

[21] Household income and employer type are not listed as independent variables because the survey respondents are already delineated by these two variables for each regression. Nonetheless, these are two key variables that, in other types of statistical analyses, could be used as independent variables.

Distance to UNC-Chapel Hill is measured (in miles) as the dependent variable controlling for a number of independent variables outlined in Table 7. The purpose of controlling for these independent variables is to create as much of an "apples-to-apples" comparison as possible between the residential location choices of different employee types. The variables are outlined here by each name and source (see Appendix 1 for specific survey question response options). The identification of these variables is founded on the research highlighted by Turner and O'Neal (1986) as discussed in Chapter 3.

7.5 Key Assumptions for Analysis

There are a few assumptions needed to conduct this analysis because of unavailable data or the limits of existing data. Ideally, this analysis would include information on these data points. When possible, notes have been made on how future studies could improve this analysis.

Manipulating the Income Boundaries

Working households, as defined by the Urban Land Institute, earn between 60% and 120% AMHI. Because the data available from UNC-Chapel Hill DPS provided only employees household incomes broken into specific categories, income brackets needed to be altered to 63% to 135% to prevent loss of information or inaccurate assumptions. The upper income limit is slightly higher than would have been preferred; it is unclear how many surveyed employees fall within the 120% to 135% AMHI bracket and therefore would not have been included in an analysis with stricter income boundaries. The same is true for unconstrained households – while 200% AMHI is the ideal income limit, available data forced that limit higher to 216% AMHI, again forcing the income limits higher. Future studies would benefit from surveys with specific questions on household income or smaller income bracket ranges.

Determination of Two-Worker Households

The 2009 survey did not provide information on whether a household contains two or more workers. The number of adults in the household was provided, and this study assumes that if a household reported having more than one adult, that household would be considered as a two-worker household. This assumption will not be completely accurate – an adult may have elderly parent(s) living with him/her or have a spouse/partner that is not employed. Nonetheless, the

determination of a two-worker household is an important consideration when differentiating households by income as those defined as "unconstrained" may be more likely to have two workers contributing income to household costs. Future studies could improve the accuracy of these results by specifically asking if the respondent's spouse/partner earns income.

Location of UNC-Chapel Hill

All straight-line distances are measured from the home location (nearest intersection) of an employee to a fixed point location referred to as UNC-Chapel Hill. The exact location of this point is the intersection of South Road and Stadium Drive on the UNC-Chapel Hill campus (near the Bell Tower and the Student Stores). Unlike many large universities, UNC-Chapel Hill is relatively condensed and distances do not greatly differ between institutions.

New Employees Move to the Area

All estimations made on the distance that new employees would live from UNC-Chapel Hill are dependent on the assumption that the new employees have no previous ties to the area. All residential location choice decisions are therefore based on the variables that are captured in this analysis. The ideal new employee would have no previous knowledge of the area, nor family or friend connections in a certain area. While this is highly unlikely considering the variability not captured in the analysis (see below), it is a worthwhile assumption for demonstrating how one might estimate radial living distance from UNC-Chapel Hill for future employees.

Margins of Error

The 2005-2009 ACS data provides margins of error for all of its demographic estimates. For this analysis, only the estimates were used. This analysis did not include a degree of statistical analysis complex enough to be able to incorporate the margins of error. Given that many of the results in Chapter 8 are highly statistically significant ($p < .001$), it is unlikely that small margins of error would have strongly impacted these results across the larger sample sizes.

Missing Independent Variables

Additional independent variable information on *individuals*, such as the employee's race, would greatly improve the accuracy of the results. Future iterations of the employee survey distributed

by UNC-Chapel Hill DPS could include these variables (see Chapter 10 for more discussion). In this analysis, there is no proxy variable for the employee's race as that could not be accurately estimated from the information available.

A few *household* variables, such as number of adults and children in the household, are provided by the survey responses. Additional information such as whether the household owns or rents the residence would be helpful, as the desire for home ownership strongly affects potential residential locations. Because of its importance, this variable is tested by the comparison of rental and ownership tenure at the block group (neighborhood) level. There is also no information on where the second worker in a two-worker household is employed, thus preventing the addition of an independent variable that measures the commuting distance of the second worker.

Lastly, Guo and Bhat (undated) suggest the use of an additional variable – "accessibility" – to determine residential location choice. The authors' three measurements of accessibility are the distances to (1) recreational opportunities (measured through proximity to park land acreage); (2) shopping opportunities; and (3) other basic employment opportunities. For the first two measures in particular, this study would have benefited from additional independent variables controlling for these distances as access to indicate additional "lifestyle" factors outside of employment and household characteristics that may impact housing location choice.

Chapter 8 – Results of Residential Preferences Analysis

This chapter is organized to answer two of the three research questions identified in Chapter 6 using available data and the outlined methodology:

- What are the differences in housing location patterns between current *workforce* and *unconstrained* households employed by UNC-Chapel Hill and UNC Hospitals?
- For workforce and unconstrained households, what are the statistically significant *household* and *neighborhood characteristics* that correspond with each population's residential location choices?

8.1 Comparing Two Populations – Aggregated Information

Table 8 compares household characteristics of all employees surveyed in 2009 by whether they are workforce or unconstrained households using the income definitions determined above. The information in this table maintains the aggregated workforce household data to demonstrate the macro patterns that exist between employees when delineated by household income alone.

When comparing all workforce employee households to unconstrained employee households, a number of patterns emerge. First, workforce employees tend to be aged between 25 and 64 years old, with fairly even distributions among the middle three age ranges. Unconstrained employees tend to be older, with almost one-half of unconstrained workers being aged more than 50 years old (compared to 32.0% of workforce households). Second, the proportion of male employees in unconstrained households is more than twice that of males in workforce households. Females represent almost three-quarters of the workforce employee population.

The number of two-worker households is even more distinct – approximately 56% of workforce households have two income-earning workers, while more than 94% of unconstrained households have two workers. The higher percentage of two workers in unconstrained households is not surprising by itself – two incomes paying for a household budget is much more likely to lead to higher household incomes. However, the *degree* of the difference – 94% compared to 56% – is stark. This high percentage could be used to further reinforce the evidence of uniquely high housing prices in the Chapel Hill region. To be denoted as unconstrained in residential location choices, a household is almost *required* to have two incomes. A very small

proportion of employees earn enough income to be designated as a single-worker, unconstrained household. Consequently, this income requirement will significantly impact the housing choices of single-worker households.

Table 8: Household Characteristics of 2009 Survey Respondents by Income

	Workforce HHs (n = 413)	Unconstrained HHs (n = 219)
Age of Employee		
18-24 years	18 (4.4%)	0
25-34 years	119 (28.8%)	26 (11.9%)
35-49 years	141 (34.1%)	84 (38.4%)
50-64 years	127 (30.8%)	97 (44.3%)
65 years or more	5 (1.2%)	11 (5.0%)
No Response	*3*	*1*
Gender of Employee		
Male	98 (23.7%)	102 (47.2%)
Female	309 (74.8%)	114 (52.8%)
No Response	*6*	*3*
Does the Employee Live in a Two-Worker Household?		
No	182 (44.1%)	13 (5.9%)
Yes	231 (55.9%)	206 (94.1%)
Number of Children in the HH Ages 0-5 Years		
0	371 (89.8%)	171 (78.1%)
1	26 (6.3%)	26 (11.9%)
2	16 (3.9%)	21 (9.6%)
3	0	1 (less than 1%)
Number of Children in the HH Ages 6-18 Years		
0	351 (85.0%)	153 (69.9%)
1	29 (7.0%)	33 (15.1%)
2	27 (5.8%)	28 (12.8%)
3	4 (1.0%)	4 (1.8%)
4	2 (less than 1%)	1 (less than 1%)
Live in CHCCS District?		
No	299 (72.4%)	102 (46.6%)
Yes	114 (27.6%)	117 (52.4%)

Source: Analyzed from data provided by UNC-Chapel Hill DPS.

The distribution of children by employee type is also notable. Workforce households (85%) are far more likely to have no children than children of any age (compared to approximately 78% of unconstrained households). Of those households in each group that do have children, unconstrained households are almost twice as likely to have young children and more than twice

as likely to have school-aged children. Perhaps associated with this last variable, unconstrained households are almost twice as likely (52.4%) to live in the Chapel Hill-Carrboro School (CHCCS) district than workforce household employees (27.6%). Almost three-fourths of workforce household employees live outside of the CHCCS district.

In summary, workforce employees are more likely to be aged 35 to 45 years old, female with no children, living in a one-worker household outside of the CHCCS district. Unconstrained households are more likely to be aged 50 to 65 years old, male with one or two children living in a two-worker household inside the CHCCS district. While these are generalizations across 632 surveyed employees, these are patterns that emerge when comparing workforce and unconstrained households as two populations.

8.2 Comparing Three Populations – Disaggregated by Employer

After comparing workforce and unconstrained households as two larger groups, this study now disaggregates the workforce households by employer (UNC-Chapel Hill or UNC Hospitals) to differentiate between the two employers that may explore different housing development options depending on their specific workforce needs. Unconstrained employees are not disaggregated because too few unconstrained hospital employees (n = 22) were surveyed for a separate analysis.

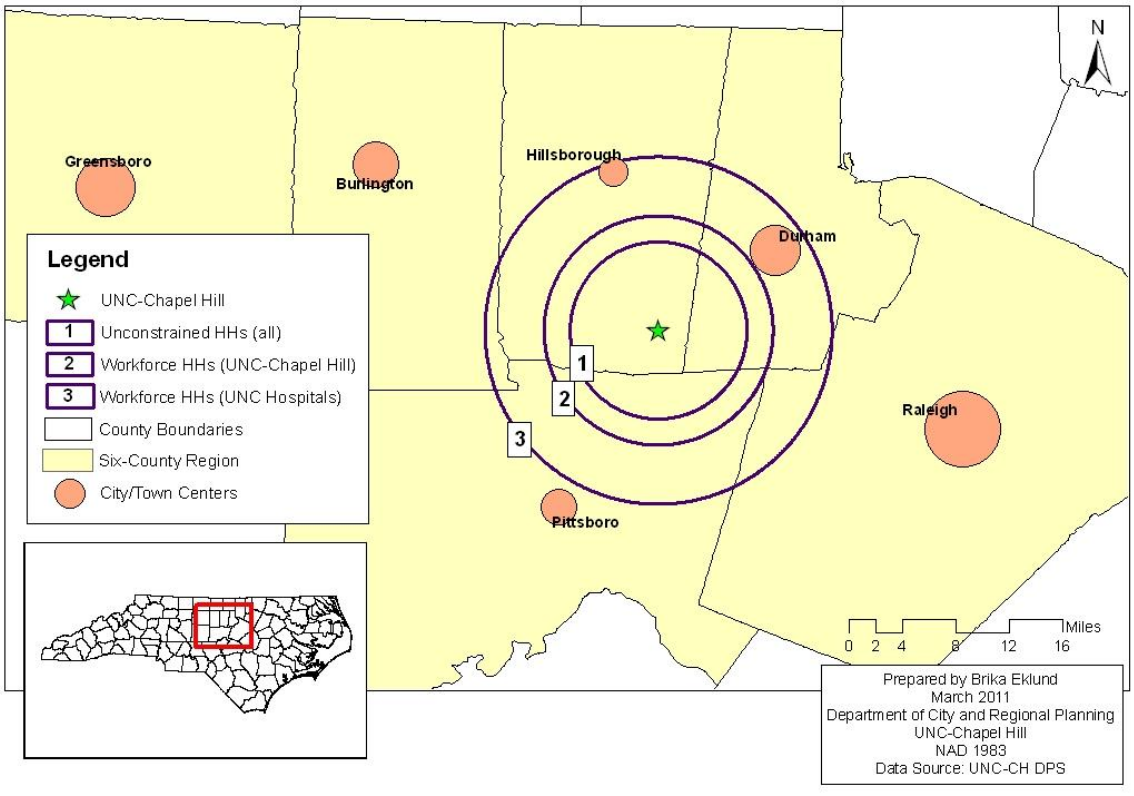
Rather than display the data by range as above, Table 9 provides the average (mean) value of each variable that is used in the analyses below compared to the variable means from the six-county study region. The purpose is to describe the different "leanings" of the variables within each population, whereas Chapter 9 specifically tests the interactions between these variables and their impact on the distance lived from campus using an example data set.

The first important descriptive variable is *dist_m,* or distance lived from UNC-Chapel Hill in miles. Workforce household personnel employed by UNC-Chapel Hill live, on average, 8.61 miles from UNC-Chapel Hill. The distance is even higher for workforce employees of UNC Hospitals – employees live an average of 13.05 miles from UNC-Chapel Hill. Unconstrained households live only 6.65 miles (on average) from UNC-Chapel Hill. The cost implications of these different commuting distances are explored in Chapter 10.

Table 9: Mean Values of Each Variable Disaggregated by Employer[22]

	Variable	Workforce HHs – UNC-Chapel Hill	Workforce HHs – UNC Hospitals	Unconstrained HHs – All	Six-County Region
	dist_m	8.6071	13.0467	6.6471	*n/a*
Individual + Household	*two_work*	0.5536	0.5726	0.9406	*n/a*
	child_05	0.1315	0.1613	0.3242	*n/a*
	child_618	0.1799	0.4113	0.4795	*n/a*
	gender	0.6996	0.8952	0.5278	*n/a*
	age	3.9896	3.7823	4.4064	*n/a*
Neighborhood	*popdens_09*	1738.8278	1704.7670	1525.4529	572.3561
	popbl_per	0.1860	0.2062	0.1246	0.2423
	popas_per	0.0520	0.0514	0.0723	0.0396
	pophisp_per	0.0597	0.0623	0.0457	0.0824
	med_hhi	$57,019.08	$61,555.28	$73,960.94	$51,562.83
	med_value	$228,923.88	$208,876.61	$301,096.35	$182,183.33
	vac_rate	0.0882	0.0845	0.0768	0.0948
	occowner_per	0.5519	0.5836	0.6223	0.6424
	more_per_all	0.2619	0.2071	0.3613	0.4319
	units_1d_per	0.5705	0.5978	0.6226	0.6172

Figure 8: Average Distance (in Miles) Lived Away from Campus by Employee Sub-Group (2009)



[22] Reference Appendix 1 for the specific coding of each variable.

With regards to variables other than *dist_m*, let us focus again on the differences between workforce households employed by UNC-Chapel Hill and UNC Hospitals separately. Workforce employees with UNC Hospitals are more likely to be female, slightly younger than UNC-Chapel Hill employees, and have school-aged children. UNC Hospital employees are also more likely to live, on average, in neighborhoods with higher percentages of black/African-American residents, slightly higher percentages of Hispanic residents, higher percentages of owner-occupied housing units, and lower percentages of highly-educated (more than college) residents. Of special note, workforce employees of UNC Hospitals live in neighborhoods with higher median household incomes and lower median housing values than UNC-Chapel Hill employees.

Workforce households employed by both institutions are very different from unconstrained households. The demographics of neighborhoods in which unconstrained households live are noticeably different with the lowest percentage of black/African-American and Hispanic residents, as well as the highest proportion of Asian residents. Unconstrained households are also likely to live in a neighborhood that, on average, has a greater proportion of highly-educated residents. This finding is supported by Bayer et al. (2007, 628), who found that higher-educated households are very likely to self-aggregate with similarly educated households that through a "'social multiplier' effect" will increase housing prices.

Third, unconstrained households also live in neighborhoods with the highest median household income and median home values of the three populations. This data supports previous findings that higher-income households tend to self-segregate into higher-income neighborhoods. On average, roughly two-thirds of the housing units in unconstrained neighborhoods are single-family detached units, while a similar proportion are owner-occupied units. The housing vacancy rate is also roughly 1% lower than the average workforce housing neighborhood.

Note the comparisons between each of the sub-groups and the six-county region mean values. The average values of each neighborhood type, regardless of the employee sub-group, have different values than the six-county average. The neighborhoods are denser with lower proportions of black/African-American and Hispanic residents, higher proportions of Asian

residents, higher median household incomes and home values, lower vacancy rates, and lower percentages of owner-occupied units. The three sub-groups rank lower only on the proportion of highly-educated residents and the proportion of single-family detached units. This is likely the result of including both more urbanized (e.g. Raleigh and Greensboro) and more rural (e.g. Chatham and Alamance counties) in these mean value determinations.

8.3 Residential Preferences Indicated by Significant Characteristics

It is statistically significant that household income – whether a household is considered "workforce" or "unconstrained" – impacts household residential choice. However, income only explains a small proportion of the total factors affecting residential housing choice.[23] Many studies have shown that additional individual, household, and neighborhood factors will affect this complicated choice. This study incorporates those previously tested variables into a model that goes even further. This study delineates the 2009 survey respondents into three categories based on household income and employer type and investigates which individual, household and neighborhood characteristics correlate to residential location choice of these three sub-groups. Statistical significance is measured at 95% confidence ($p < .05$), while "very statistically significant" refers to strength at 99% confidence ($p < .001$). The probabilities (p) refer to the chance that the correlations occur by chance. Very small p-values indicate high correlations between variables. We cannot determine causation from this study; proving causation requires much more sophisticated statistical methods.

Each of the three models below includes only specific variables that do not exacerbate problems of collinearity. In statistics, collinearity refers to when two are more *independent* variables are closely correlated. If multicollinearity (multiple associations between two independent variables) exists, the coefficients will not accurately represent the relationship between the *dependent* variable and the tested independent variables and will likely over-report the degree of influence that each independent variable has on the dependent variable (in this case, on distance in miles). Each of the independent variables discussed in Table 7 were selected to reduce multicollinearity. The highest variance inflation factor (VIF) for each model is the proportion of owner-occupied

[23] While distance away from UNC-Chapel Hill is statistically correlated with income ($p > 0.000$), only 4.5% of the variations between distances lived from Chapel Hill is explained by the income variable (R-squared = .0453).

units (*occowner_per*). This is not surprising as the proportion of single-family detached units is also included in the model, and there are typically strong associations between these two variables as most single-family detached units are owner-occupied. To present this information in each model, both the highest VIF and the mean VIF are reported.[24]

Tables 10 and 11 summarize the coefficients (column B) and probabilities (column C) for each independent variable (column A). The coefficients in column B explain the "push-pull" factors away from the mean distance (shown in Table 9 above). Positive coefficients indicate the number of miles that a particular variable pushes the distance *away* from UNC-Chapel Hill. Negative coefficients pull the distance *back towards* UNC-Chapel Hill. Column C indicates the significance of each variable. Column D has standardized coefficients that compare those in column B on an "apples-to-apples" comparison showing which of the independent variables have the most influence on distance lived from UNC-Chapel Hill. The following three sections discuss the results of each statistical analysis, specifically in terms of (1) the independent variables that significantly impacts distance from UNC-Chapel Hill, and (2) the degrees of "push" and "pull" from the mean distance.

The three sections below describe these "push-pull" factors that address residential preferences and constraints. There are important individual and household variables that are not accounted for; this is a serious issue that is more fully explained in Chapter 9. However, the purpose of the analysis below is to explore those variables for which we have data and determine whether any impact the distance lived from UNC-Chapel Hill. Those variables that are significant indicate that each employee sub-group may be making residential choices based on characteristics that are common to certain distances lived from UNC-Chapel Hill, as *dist_m* is the dependent variable in the analysis.

Workforce Employees – University

Table 10 summarizes the probabilities and coefficients for workforce university employees. None of the individual or household characteristics have a statistically significant impact on

[24] For limited multicollinearity to be present, the highest VIF should not be greater than 10, and the mean VIF should not be substantially larger than 1.00.

distance lived from UNC-Chapel Hill. For example, living in a two-worker household does not produce a consistent distance away from UNC-Chapel Hill for this employee sub-group. Several neighborhood characteristics, however, do significantly correlate with the distance lived from campus for workforce university employees.

Table 10: Workforce Households Employed by UNC-Chapel Hill

Number of observations = 283
Prob > F = 0.0000
R-squared = 0.6624
Highest VIF = 7.39 (*occowner_per*)
Mean VIF = 2.42

	Variable	Coefficient (Beta)	P > |t|	Standardized Coefficient (b)
	(A)	(B)	(C)	(D)
Individual + Household	*two_work*	-0.8202	0.150	-0.0559
	child_05	0.6386	0.298	0.0386
	child_618	0.2680	0.583	0.0203
	gender	0.2864	0.626	0.0180
	age	0.0476	0.875	0.0061
Neighborhood	*popdens_09*	-0.0007	0.000**	-0.1727
	popbl_per	-7.3274	0.000**	-0.1513
	popas_per	-5.4079	0.344	-0.0422
	pophisp_per	20.5268	0.000**	0.1957
	med_hhi	0.00003 (0)	0.177	0.0920
	med_value	-0.0002 (0)	0.000**	-0.2651
	vac_rate	6.4575	0.217	0.0474
	occowner_per	3.2705	0.278	0.1052
	more_per_all	-20.9310	0.000**	-0.4477
	units_1d_per	5.4329	0.024*	0.1706
	_cons	13.2615	0.000	

*Statistically significant at p < .05 (95% confidence interval)
**Statistically significant at p < .001 (99% confidence interval)

Workforce households employed by UNC-Chapel Hill are highly likely to live certain distances away from campus that correlate with neighborhoods that have very similar population densities, proportion of black/African-American residents, and proportion of Hispanic residents. The proportion of Asian residents in the neighborhood has no statistically significant impact on the distance away from campus. Workforce employees are also likely to live in neighborhoods with similar median home values and proportions of single-family detached units. Lastly, these employees are highly likely to live in neighborhoods that have similar proportions of highly-educated residents. The large standardized coefficient (column D) value for educational status

(beta = -0.4477) indicates that the higher educational status of the neighborhood is the most influential independent variable dictating the distance lived from UNC-Chapel Hill.

The coefficients shown in column B indicate the "push-pull" distance factor away from the mean distance of 8.61 miles lived away from Chapel Hill. Of the statistically significant variables, the proportion of Hispanic residents and the proportion of highly educated residents create the most change in distance lived away from UNC-Chapel Hill. Proportion of black/African-American residents and the proportion of single-family detached units have a lesser impact on distance. Population density and median home values do not alter the distances.

Workforce Employees – Hospital

Compared to workforce households employed by UNC-Chapel Hill, there are fewer independent variables that correlate with the distance lived away from campus for this population. This is likely the result of more varied residential locations of the surveyed hospital employees, thus creating challenges in indentifying common neighborhood characteristics based on distance lived from campus.[25] Nonetheless, workforce hospital employees are likely to live in neighborhoods with similar proportions of Asian residents, as well as similar median household incomes. There are no correlations between the distance lived from campus and the neighborhood's proportion of black/African-American residents, Hispanic residents, or housing indicators (such as median home value or number of single-family detached units).

The only independent variable that is highly significant is proportion of highly educated residents. This variable has, by far, the largest impact on the distance lived from UNC-Chapel Hill (beta = -0.6898). Taken together, these findings indicate that workforce household employees of UNC Hospitals are residing certain distances away from campus that correspond with communities that have more Asian residents, similar household incomes and similar education levels.

[25] The ideal number of independent variables for analysis is one per 15 individuals sampled. Because the sample size of workforce households employed by UNC Hospitals is smaller (n = 124) than the ideal number (n = 225), this could also impact the significance of the findings.

The median household income has little impact on the distance lived from UNC-Chapel Hill in terms of magnitude of affecting the mean distance of 13.05 miles. Proportion of Asian residents and proportion of highly educated residents, however, has a large impact. Both variables pull the distance lived away from UNC-Chapel Hill back inwards.

Table 11: Workforce Households Employed by UNC Hospitals

Number of observations = 124
Prob > F = 0.0000
R-squared = 0.5160
Highest VIF = 11.67 (*occowner_per*)[26]
Mean VIF = 2.87

	Variable	Coefficient (Beta)	P > |t|	Standardized Coefficient (b)
	(A)	(B)	(C)	(D)
Individual + Household	*two_work*	-0.1168	0.930	-0.0067
	child_05	-0.0842	0.951	-0.0046
	child_618	-0.2930	0.686	-0.0288
	gender	-1.0777	0.582	-0.0385
	age	-0.0222	0.971	-0.0027
Neighborhood	*popdens_09*	-0.00006 (0)	0.893	-0.0125
	popbl_per	-0.7283	0.864	-0.0133
	popas_per	-32.7041	0.011*	-0.2238
	pophisp_per	-6.2476	0.509	-0.0529
	med_hhi	0.0001	0.037*	0.2969
	med_value	4.78e-06 (0)	0.706	0.0511
	vac_rate	-6.8208	0.533	-0.0503
	occowner_per	3.3985	0.671	0.0975
	more_per_all	-47.2054	0.000**	-0.6898
	units_1d_per	-4.8340	0.407	-0.1485
	_cons	20.1698	0.000	

*Statistically significant at p < .05 (95% confidence interval)
**Statistically significant at p < .001 (99% confidence interval)

Unconstrained Employees – University and Hospital

Unlike workforce employees that are disaggregated by employer, all unconstrained employees surveyed in 2009 were analyzed together to produce the results summarized in Table 12. Again, no individual or household variables are significantly correlated with distance lived away from

[26] As noted in footnote 23, the highest ideal VIF in any model is 10. Obviously, this VIF is higher than desired; however, this study maintains the existing model because it is the exact same as the other two and can thus be directly compared. The highest VIF was not too far away from the ideal target to warrant a recalibration. It is simply worth noting that the R-squared value may be slightly higher than ideal and that the coefficients may not be as accurate as possible with another, less collineated model.

UNC-Chapel Hill. However, six of the ten neighborhood variables were highly statistically significant and one was very significant – the most independent variables of any three employee sub-groups. Unconstrained employees are very likely to live certain distances away from campus that correspond with similar demographics, housing stock, and education levels.

Table 12: Unconstrained Households Employed by UNC-Chapel Hill or UNC Hospitals

Number of observations = 216
Prob > F = 0.0000
R-squared = 0.7376
Highest VIF = 8.56 (*occowner_per*)
Mean VIF = 2.59

	Variable	Coefficient (Beta)	P > |t|	Standardized Coefficient (b)
	(A)	(B)	(C)	(D)
Individual + Household	*two_work*	1.4688	0.147	0.0551
	child_05	-0.3670	0.345	-0.0380
	child_618	-0.2241	0.444	-0.0290
	gender	-0.7510	0.123	-0.0591
	age	-0.0046	0.989	-0.0006
Neighborhood	*popdens_09*	0.0008	0.000**	0.1772
	popbl_per	-13.7552	0.000**	-0.2369
	popas_per	0.3669	0.935	0.0038
	pophisp_per	18.3883	0.000**	0.1681
	med_hhi	0.0001	0.000**	0.4874
	med_value	-0.00001 (0)	0.007*	-0.1763
	vac_rate	-3.0886	0.613	-0.0219
	occowner_per	-6.8287	0.038*	-0.2208
	more_per_all	-35.9539	0.000**	-0.8650
	units_1d_per	4.5134	0.111	0.1397
	_cons	15.9509	0.000	

*Statistically significant at p < .05 (95% confidence interval)
**Statistically significant at p < .001 (99% confidence interval)

More specifically, unconstrained households are highly likely to live certain distances away from campus that correspond with similar population densities as well as proportions of black/African-American and Hispanic residents. Unlike the two workforce housing groups, *both* median household income and median home values are similar and significant in distance lived from UNC-Chapel Hill. The proportion of owner-occupied units is also significant. Lastly, the proportion of highly educated residents also significantly impacts distance. While the proportion of highly educated residents is the most influential variable affecting distance in the previous two

models, the neighborhood's median household income is the most influential for unconstrained households (beta = 0.4874). The three variables that have no significant impact on residential location choice are the proportion of Asian residents in the neighborhood, the vacancy rate, or the proportion of single-family detached units.

With regards to coefficients, median household income and median home values in the neighborhood have little impact on distance lived from UNC-Chapel Hill. The proportion of black/African-American residents and proportion of Hispanic residents pull and push the distances, respectively, but at approximately the same magnitude. As with the other models, the proportion of highly-educated residents in the neighborhood draws the distance closer back towards UNC-Chapel Hill.

Chapter 9 – Residential Location Choices of New Workforce Employees

The former chapter uses data gathered on current employees to describe *existing* residential locations and to identify patterns. This chapter strives to answer the third research question presented in Chapter 6:

- If household income did not factor in housing location preferences, what is the expected distance away from UNC-Chapel Hill that *future, non-resident, workforce household employees* would live if newly employed by either institution?

This research question is critical to helping university and hospital administrators determine the "market demand" for employer-assisted housing among the workforce population. Assuming that workforce households may select housing absent income constraints, will these employees want to live closer to UNC-Chapel Hill or further away from the current average distance?

The analysis demonstrated below is an *example* of how administrators could analyze the impact of removing income constraints from the residential location choices of workforce populations. Before continuing, the reader must clearly understand two primary caveats to this example: (1) the data provided by UNC-Chapel Hill DPS does not capture information on *race, ethnicity,* or *educational status* of the survey respondents, and (2) published research studying residential preferences uses much more sophisticated statistical methodology to compare the correlations between variables.

First, research has shown that race, ethnicity and educational status are among the most powerful indicators of residential housing preferences (Charles 2005; Bayer et al. 2007). Because UNC-Chapel Hill DPS does not capture this information in the 2009 survey, these indicators could not be included in the analysis in Chapter 8. The results below demonstrate where workforce households could live if income was removed as a *constraining* factor, but these variables are still missing which could influence household *preferences*. With more information on the characteristics of survey respondents, the methodology below could provide greater illumination on likely residential locations for new workforce employees.

Second, the regression used in Chapter 8 sufficiently illustrates the effects that high housing prices and lower wages have on the housing options available for low- and moderate-income workers. However, it is worth noting that published studies by researchers use more sophisticated regression models to investigate residential choices similar to those briefly described in Chapter 3.2. It is possible that those regressions may capture nuances that this methodology cannot recognize.

With these cautions in mind, this example demonstrates the preferential distance lived away from UNC-Chapel Hill for workforce households if income did not factor into choice. The preferences of unconstrained households are applied to workforce households to determine the possible distance lived from campus. The mean (C) for each workforce household variable (A) is multiplied by the unconstrained household coefficient (B) to determine the "push/pull" factor (D) away from the mean distance. As described above, the "push/pull" factor indicates whether the presence of a certain variable is likely to drive the distance from UNC-Chapel Hill further away (positive = push) or closer (negative = pull).

For workforce households employed by UNC-Chapel Hill, the mean distance lived away from campus using workforce household data is 8.61 miles. However, once the preferences of unconstrained employees are applied, the mean distance lived away from UNC-Chapel Hill increases to 10.90 miles (see Figure 9). Thus, the preferred distance lived away from Chapel Hill increases by 26.6% for workforce university employees. If workforce household employed by UNC-Chapel Hill did not have income constraints and had the exact same preferences as unconstrained households, they would likely live substantially further away from campus.

Workforce households employed by UNC Hospitals live an average of 13.05 miles away from UNC-Chapel Hill; once unconstrained preferences are applied, the distance decreases to 12.80 miles lived away from campus. The preferred distance lived away from Chapel Hill decreases by 1.9%. These households employed by UNC Hospitals would live only slightly closer to UNC-Chapel Hill if income constraints did not factor into residential housing choice and the preferences of workforce households fully mirrored those of unconstrained households as analyzed in Chapter 8.

Table 13: Unconstrained Coefficients and Workforce Means – University

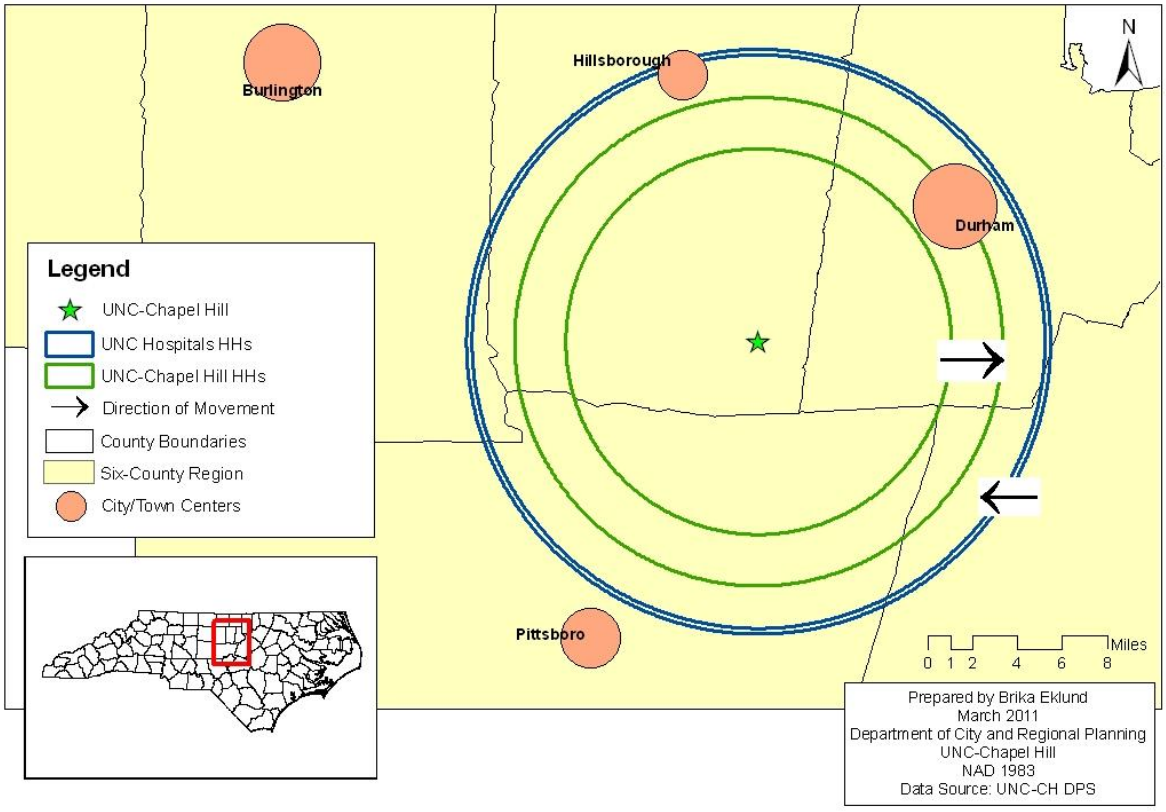
	Variable	Unconstrained Coefficient	Workforce HHs – University	Push/Pull Distance from Mean
	(A)	(B)	(C)	(D)
Individual + Household	*two_work*	1.4688	0.5536	0.8131
	child_05	-0.3670	0.1315	-0.0483
	child_618	-0.2241	0.1799	-0.0403
	Gender	-0.7510	0.6996	-0.5254
	Age	-0.0046	3.9896	-0.0184
Neighborhood	*popdens_09*	0.0008	1738.8278	1.3911
	popbl_per	-13.7552	0.1860	-2.5585
	popas_per	0.3669	0.0520	0.0191
	pophisp_per	18.3883	0.0597	1.0978
	med_hhi	0.0001	57019.0830	5.7019
	med_value	-0.00001 (0)	228923.8754	0
	vac_rate	-3.0886	0.0882	-0.2724
	occowner_per	-6.8287	0.5519	-3.7687
	more_per_all	-35.9539	0.2619	-9.4163
	units_1d_per	4.5134	0.5705	2.5749
	_cons	15.9509		15.9509
Total distance (miles) lived from UNC-Chapel Hill				**10.9005**

Table 14: Unconstrained Coefficients and Workforce Means – Hospitals

	Variable	Unconstrained Coefficient	Workforce HHs – Hospital	Push/Pull Distance from Mean
	(A)	(B)	(C)	(D)
Individual + Household	*two_work*	1.4688	0.5726	0.8410
	child_05	-0.3670	0.1613	-0.0592
	child_618	-0.2241	0.4113	-0.0922
	Gender	-0.7510	0.8952	-0.6723
	Age	-0.0046	3.7823	-0.0174
Neighborhood	*popdens_09*	0.0008	1704.7670	1.3638
	popbl_per	-13.7552	0.2062	-2.8363
	popas_per	0.3669	0.0514	0.0189
	pophisp_per	18.3883	0.0623	1.1456
	med_hhi	0.0001	61555.2823	6.1555
	med_value	-0.00001 (0)	208876.6129	0
	vac_rate	-3.0886	0.0845	-0.2610
	occowner_per	-6.8287	0.5836	-3.9852
	more_per_all	-35.9539	0.2071	-7.4461
	units_1d_per	4.5134	0.5978	2.6981
	_cons	15.9509		15.9509
Total distance (miles) lived from UNC-Chapel Hill				**12.8042**

The mean distances determined above for university and hospital employees – 10.9 miles and 12.8 miles, respectively – are examples of the "ideal" distances lived away from UNC-Chapel Hill assuming that new workforce employees' preferences are fully captured by the variables presented. This example demonstrates a methodology that can be used if UNC-Chapel Hill or UNC Hospitals hired a new employee without previous connections to the region and wanted to test the likely preferred distance lived away from campus. With the variables captured in this analysis, the new employee would prefer to live more than ten miles away from campus.

Figure 9: Distance (in Miles) Lived Away from UNC-Chapel Hill – Before and After Application of Unconstrained Households (HHs) Residential Preferences (2009)



Chapter 10 – Discussion and Conclusion

This study seeks to determine whether patterns exist between the residential preferences of workforce households and unconstrained households employed by UNC-Chapel Hill and UNC Hospitals. All surveyed employees are separated into three categories – UNC-Chapel Hill workforce employees, UNC Hospitals employees, and unconstrained households employed by either institution. The significant results in Chapter 8 indicate that each sub-group of employees do appear to live certain distances from campus that correspond with particular neighborhood characteristics but not with individual or household characteristics. Across sub-groups, the proportion of highly educated residents is significant, while race/ethnicity and housing characteristics are significant to varying degrees based on sub-group. Chapter 9 demonstrates an example of the residential preferences of newly-employed workforce households if income was not a constraining factor, assuming that all preferential variables are included in the analysis.

These results are important to UNC-Chapel Hill and UNC Hospital administrators interested in pursuing opportunities for workforce housing development for three reasons. First, decision makers must recognize that *there are many variables to consider* when deciding where to develop workforce housing. While zoning ordinances, existing land ownership, and politics each contribute to real estate development decisions, the residential choice preferences of potential tenants is critical to the success of any project. This study begins the necessary process of extensive data analysis; however, the study would be greatly improved by additional individual and household data such as the race, ethnicity, and educational status of the survey respondents. The information contained within this study is meant to serve primarily as a cautionary guide to university and hospital administrators as they continue discussions about workforce housing development – additional data is needed to fully understand the residential choice preferences of the workforce. By applying the models in this paper to a larger sample size with more data collected, both institutions would have a much better idea of the market demand for any workforce housing at a number of locations both within and outside of Chapel Hill town limits.

Second, it is possible that workforce employees may not choose to live in sponsored developments unless those developments either have or are perceived to have certain *preferred*

neighborhood characteristics. This may be the case whether or not a development is located closer to campus, within the CHCCS district, or containing other features. Certain characteristics may be within the control of the development entity, such as housing cost and type. Others, however, cannot be controlled legally (such as residents' racial composition) or with relative ease (such as income levels absent housing cost controls) by the developer. Administrators must be open to the possibility that residents will not want to live within university-managed developments unless these preferences are met.

Third, decision makers may also need to recognize that workforce employees *prefer to live further away from UNC-Chapel Hill* than may be desirable from the perspective of other policy implementations, such as greater public transit use and more dense urban living in the downtown Chapel Hill urban core. This conclusion is cautionary – as the study describes above, there are variables and alternative methodology that could be used to more strenuously test this claim. However, should these results hold steady, each administration would need to consider alternative avenues through which to supply workforce housing, such as additional land purchase or partnerships with campuses in other communities, in order to satisfy market demand.

10.1 Preferred Neighborhood Characteristics

After looking closely at the existing distances lived from UNC-Chapel Hill, no individual or household characteristics are statistically correlated for any population. For example, the number of two-worker households or the number of school-age children does not significantly correlate to the type of neighborhood (by distance) of university or hospital employees. As for neighborhood characteristics, there were varying instances of significance. The racial composition of neighborhoods is not always significant in residential location choice for employees. For both workforce and unconstrained employees employed by UNC-Chapel Hill, the proportions of black/African-American and Hispanic residents in a neighborhood correlates with residential location. On the other hand, the proportion of neighborhood Asian residents is much more significant than other racial/ethnic groups for workforce households employed by UNC Hospitals. Further studies that capture the race/ethnicity of each employee could be used to determine whether employees are more likely to congregate in communities of *similar* races and ethnicities. For example, the significant proportion of Asian residents in neighborhoods

chosen by UNC Hospitals' workers might indicate that more of these employees are Asian themselves and thus prefer to live around people of similar backgrounds.

Unconstrained households have the highest number of number of independent variables that are statistically significant when correlated with distance lived from campus. The high number of statistically significant variables indicates fairly uniform preferences amongst these employees. There are also likely fewer neighborhoods with characteristics desirable to high-income individuals and families, and these employees also have the ability to self-select residential location based on mostly personal factors through unconstrained income. This result was not unexpected based on previous research and demonstrates quite a bit of homogeneity in housing location choice of higher-income employees.

The tabulated results presented in Chapter 8 indicate that there are clear differences between the individual and household characteristics of workforce and unconstrained employees. If UNC-Chapel Hill or UNC Hospitals produce workforce housing, the survey responses indicate that developments should target employees across the age ranges (from 25 to 64 years old) of both one- and two-worker households with varying household sizes (often with no children). The degree of heterogeneity in perceived housing unit type is greater than with unconstrained households because of the variety of employee types that could be accommodated.

10.2 Distance Lived from UNC-Chapel Hill

The example demonstrated in Chapter 9 indicates that the average distance lived from campus would change for both sub-groups of workforce employees if income was not a constraining factor in housing choice and preferences mirrored those of unconstrained households; however, the differences were in far different degrees. Using a larger data set with more robust survey responses, any findings from the presented methodology could be very significant in the institutions' consideration of workforce housing development on university-owned property such as University Square or Carolina North. Both properties are located with Chapel Hill town limits and are less than three miles from campus; if future studies indicate that residential preferences correspond with further distances lived from campus, a certain portion of the employee population would be unlikely to live in housing close to campus. While the final numbers may

not be high enough to result in a vacant 20-unit residential building, results such as these could impact large, comprehensive workforce housing programs of UNC-Chapel Hill or other institutions around the country.

Despite potential preferences, living further away from UNC-Chapel Hill does not come without an economic cost. Considering the average existing residential locations of each employee sub-group, the complications of that commute could be an influential factor that is not fully explored in this study. Assuming that all three employee sub-groups drive to and from work each day, five days a week, fifty weeks per year, workforce households employed by UNC-Chapel Hill are going to pay 29.5% more in transportation costs than unconstrained employees. Even worse, workforce households employed by UNC Hospitals will pay *an astounding 96.3%* more in transportation costs than unconstrained households.[27] Whether or not this additional cost is offset by less expensive housing (and other) costs in this context remains to be further explored.

10.3 Future Studies

The findings presented in this study are based on the inclusion of fifteen individual, household, and neighborhood independent variables that help indicate residential location choice. Before moving forward with these findings to guide any policy implementation, further studies should be conducted that capture all of the variables that likely factor into the distances lived from UNC-Chapel Hill. The R-squared values for each regression provide indicate the degree of missing variables, where the regressions are shown to capture between 51.6% (workforce hospital employees) and 73.8% (unconstrained employees) of the variability. With larger sample sizes and more independent variables, future studies could hopefully capture even greater explanatory variables for distance lived away from UNC-Chapel Hill.

In particular, future studies should capture the race, ethnicity and educational status of survey respondents, as well as the differential degrees of school quality between the CHCCS district and surrounding county school districts. This could be easily accomplished by including these variables in the bi-annual transportation mode choice survey conducted by UNC-Chapel Hill

[27] Transportation costs are based on the 2011 mileage reimbursement rate of $0.51 announced by the Internal Revenue Service (2010).

DPS. More in-depth studies, likely outside of the purview of DPS, would also capture the degree of family linkages to surrounding communities, the length of time employed by either institution, the length of time lived in the employee's current residence, and other variables that may indicate the level of "attachment" to the employee's current community. Using these variables, both institutions could likely more accurately predict the preferred residential locations of new workforce employees.

In the coming years, any efforts by UNC-Chapel Hill or UNC Hospitals to provide workforce housing to its employees will require a thorough knowledge of the current supply and demand of housing in the area, as well as employee preferences as explored in this study. Chapel Hill lacks affordable housing supply, but it is still somewhat unclear whether the Town or either institution could provide housing within town limits that meet the full set of demands of workforce households. Any increase in the supply of workforce housing for employees will likely help to retain these employees as they grow their families in place in Chapel Hill, but the degree of success will depend on the institutions' abilities to address existing constraints and capture preferences of their market population – the workforce housing employees themselves.

Appendix 1

Coding Key for Individual and Household Variables

Includes individual and household questions from the original 2009 UNC-Chapel Hill DPS Mode Survey, as well as questions created by the author (based on the 2009 DPS data) specifically for this analysis.

Variable	Question (original DPS survey ID, if applicable)	Possible Answers
how_far	How far is it from home to your workplace? (q1)	1 – Less than 2 miles 2 – 2-5 miles 3 – 6-10 miles 4 – 11-20 miles 5 – 21-30 miles 6 – Over 30 miles
adults	Number of adults who live in your household	Answers vary (discrete)
two_work	Is this household a two-worker household?	0 – No 1 – Yes
child_05	Number of children (0-5 years) who live in your household (q16b)	Answers vary (discrete)
child_618	Number of children (6-18 years) who live in your household (q16c)	Answers vary (discrete)
gender	Sex [of respondent] (q17)	0 – Male 1 – Female
age	Age [of respondent] (q18)	2 – 18-24 years 3 – 25-34 years 4 – 35-49 years 5 – 50-64 years 6 – 65 years or more
hos_ft	Are you a full-time UNC Hospitals employee?	0 – No 1 – Yes
univ_ft	Are you a full-time UNC-Chapel Hill employee?	0 – No 1 – Yes
w_uncon	Are you a member of a “workforce” or “unconstrained” household as defined by the research parameters?	0 – Workforce HH 1 – Unconstrained HH
chccs	Is this household located in the Chapel Hill-Carrboro City School District?	0 – No 1 – Yes

Appendix 2

Statistical Regression Outputs

Population 1: Workforce Households – Employed by the University

```
. regress dist_m two_work child_05 child_618 gender age popdens_09 popbl_per popas_per pophisp_per med_hhi med_value v
> ac_rate occowner_per more_per_all units_1d_per, beta
```

Source	SS	df	MS	Number of obs =	283
Model	9950.17049	15	663.344699	F(15, 267) =	34.93
Residual	5070.99436	267	18.9924883	Prob > F =	0.0000
				R-squared =	0.6624
Total	15021.1649	282	53.266542	Adj R-squared =	0.6434
				Root MSE =	4.358

dist_m	Coef.	Std. Err.	t	P>|t|	Beta
two_work	-.8202404	.5678857	-1.44	0.150	-.0559087
child_05	.6385631	.6119899	1.04	0.298	.0386037
child_618	.2680098	.4877165	0.55	0.583	.0203315
gender	.2864229	.5873503	0.49	0.626	.0180221
age	.0476391	.3017932	0.16	0.875	.0060581
popdens_09	-.0007201	.0002027	-3.55	0.000	-.1727493
popbl_per	-7.327414	2.017222	-3.63	0.000	-.1513359
popas_per	-5.407878	5.708683	-0.95	0.344	-.0422458
pophisp_per	20.52684	4.499588	4.56	0.000	.1957471
med_hhi	.0000273	.0000202	1.35	0.177	.0919979
med_value	-.0000202	5.23e-06	-3.86	0.000	-.2650906
vac_rate	6.457495	5.22263	1.24	0.217	.0474418
occowner_per	3.27049	3.006637	1.09	0.278	.1051536
more_per_all	-20.93097	3.338669	-6.27	0.000	-.4477149
units_1d_per	5.432856	2.395074	2.27	0.024	.1705841
_cons	13.26146	2.257627	5.87	0.000	.

```
. estat vif
```

Variable	VIF	1/VIF
occowner_per	7.39	0.135299
units_1d_per	4.47	0.223573
more_per_all	4.03	0.247917
med_value	3.73	0.267930
med_hhi	3.65	0.273818
popdens_09	1.87	0.534546
popas_per	1.57	0.635759
pophisp_per	1.46	0.686730
popbl_per	1.37	0.728431
two_work	1.19	0.843877
age	1.16	0.858449
vac_rate	1.16	0.858826
child_618	1.08	0.923647
child_05	1.08	0.923721
gender	1.08	0.925742
Mean VIF	2.42	

Population 2: Workforce Households – Employed by the Hospital

```
. regress dist_m two_work child_05 child_618 gender age popdens_09 popbl_per popas_per pophisp_per med_hhi med_value v
> ac_rate occowner_per more_per_all units_1d_per, beta
```

Source	SS	df	MS	Number of obs =	124
Model	4706.27946	15	313.751964	F(15, 108) =	7.68
Residual	4413.94416	108	40.8698534	Prob > F =	0.0000
				R-squared =	0.5160
				Adj R-squared =	0.4488
Total	9120.22363	123	74.1481596	Root MSE =	6.393

dist_m	Coef.	Std. Err.	t	P>|t|	Beta
two_work	-.1167585	1.32755	-0.09	0.930	-.0067351
child_05	-.0841606	1.362082	-0.06	0.951	-.00456
child_618	-.2930379	.7228489	-0.41	0.686	-.0287887
gender	-1.077682	1.95444	-0.55	0.582	-.0384955
age	-.0222075	.6003766	-0.04	0.971	-.002683
popdens_09	-.0000567	.0004207	-0.13	0.893	-.0124543
popbl_per	-.7283455	4.24108	-0.17	0.864	-.0133389
popas_per	-32.70408	12.66189	-2.58	0.011	-.2237526
pophisp_per	-6.247596	9.432268	-0.66	0.509	-.0529275
med_hhi	.0001089	.0000515	2.12	0.037	.2969358
med_value	4.78e-06	.0000126	0.38	0.706	.0511402
vac_rate	-6.820768	10.89908	-0.63	0.533	-.0502996
occowner_per	3.398521	7.973272	0.43	0.671	.0974826
more_per_all	-47.20535	6.720303	-7.02	0.000	-.6898148
units_1d_per	-4.834002	5.810689	-0.83	0.407	-.148503
_cons	20.16983	5.226802	3.86	0.000	.

```
. estat vif
```

Variable	VIF	1/VIF
occowner_per	11.67	0.085674
units_1d_per	7.11	0.140632
med_hhi	4.39	0.227704
med_value	4.08	0.245389
more_per_all	2.15	0.464662
popdens_09	1.91	0.523886
popas_per	1.67	0.597129
vac_rate	1.44	0.693675
pophisp_per	1.42	0.701823
popbl_per	1.35	0.742809
two_work	1.31	0.764168
child_05	1.22	0.822774
age	1.17	0.851744
child_618	1.13	0.888599
gender	1.09	0.919419
Mean VIF	2.87	

Population 3: Unconstrained Households – Employed by the University *or* Hospital (all)

```
. regress dist_m two_work child_05 child_618 gender age popdens_09 popbl_per popas_per pophisp_per med_hhi med_value v
> ac_rate occowner_per more_per_all units_1d_per, beta
```

Source	SS	df	MS	Number of obs =	216
				F(15, 200) =	37.49
Model	6408.68892	15	427.245928	Prob > F =	0.0000
Residual	2279.44118	200	11.3972059	R-squared =	0.7376
				Adj R-squared =	0.7180
Total	8688.1301	215	40.4099074	Root MSE =	3.376

dist_m	Coef.	Std. Err.	t	P>|t|	Beta
two_work	1.468829	1.008475	1.46	0.147	.0550809
child_05	-.3670079	.3877732	-0.95	0.345	-.0379626
child_618	-.2240544	.2923376	-0.77	0.444	-.0290405
gender	-.7509777	.4854183	-1.55	0.123	-.0591139
age	-.0046498	.3319886	-0.01	0.989	-.0005993
popdens_09	.000752	.0001906	3.94	0.000	.1771608
popbl_per	-13.75522	2.535284	-5.43	0.000	-.236933
popas_per	.3669403	4.491755	0.08	0.935	.0037525
pophisp_per	18.38832	4.509442	4.08	0.000	.1680944
med_hhi	.0001062	.0000166	6.40	0.000	.4873838
med_value	-.0000118	4.31e-06	-2.73	0.007	-.1762768
vac_rate	-3.088589	6.105289	-0.51	0.613	-.0219465
occowner_per	-6.828724	3.277319	-2.08	0.038	-.2208135
more_per_all	-35.95385	2.842688	-12.65	0.000	-.864977
units_1d_per	4.513378	2.821024	1.60	0.111	.1397103
_cons	15.95086	2.383616	6.69	0.000	.

```
. estat vif
```

Variable	VIF	1/VIF
occowner_per	8.56	0.116805
units_1d_per	5.81	0.172030
med_hhi	4.42	0.226483
more_per_all	3.57	0.280476
med_value	3.18	0.314349
popas_per	1.61	0.621714
popdens_09	1.54	0.650407
popbl_per	1.45	0.687865
vac_rate	1.43	0.697027
age	1.40	0.716472
pophisp_per	1.30	0.771977
child_05	1.23	0.815370
gender	1.11	0.898493
child_618	1.09	0.913692
two_work	1.09	0.917239
Mean VIF	2.59	

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